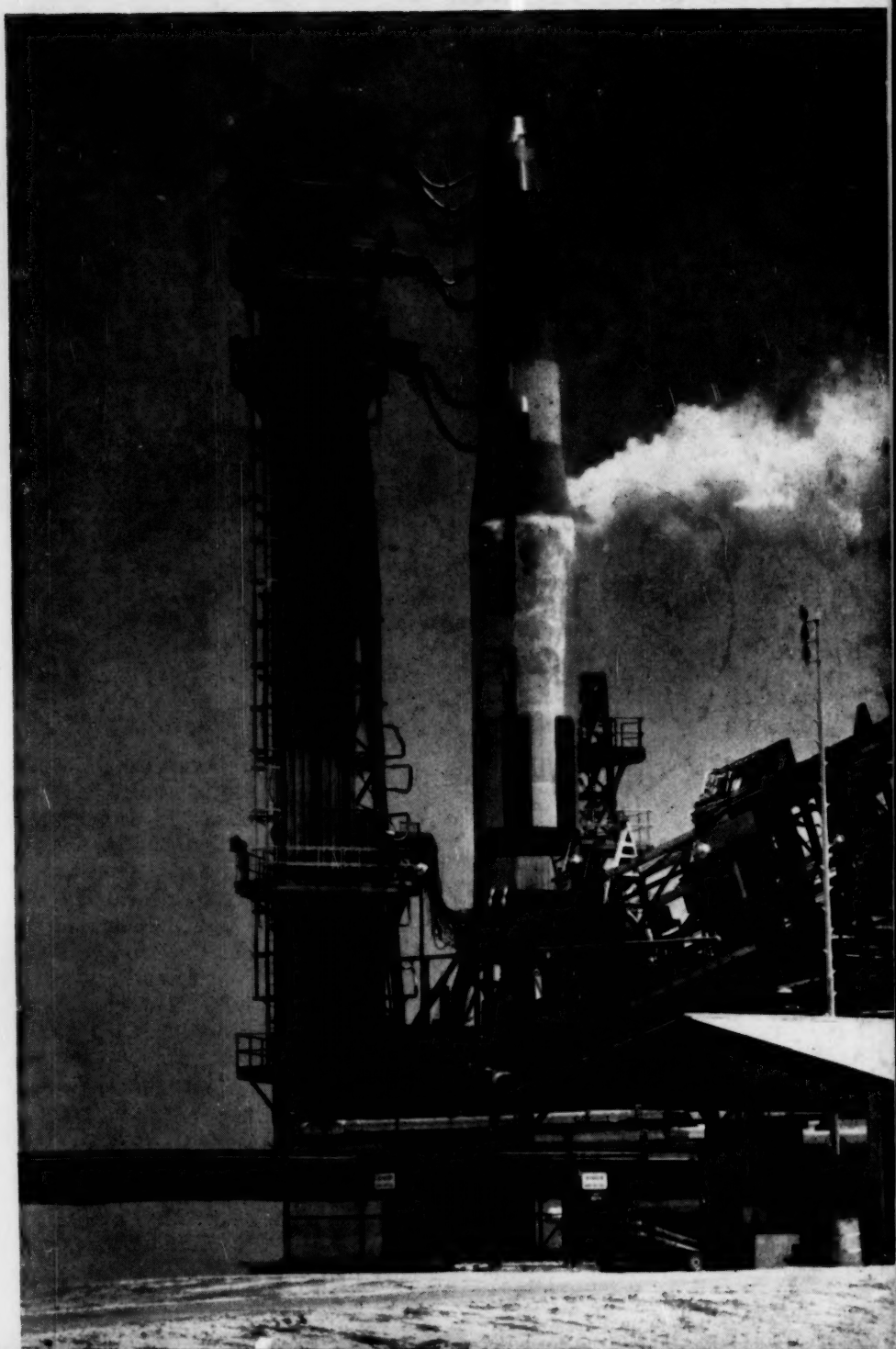
AIR CONDITIONING HEATING AND VENTILATING

SEPTEMBER 1959

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT

Preparing to test the Titan, an Air Force missile of 5500-mile range. The U. S. Air Force is the largest buyer of air conditioning and refrigeration equipment. See page 73. Official U. S. Air Force Photo.



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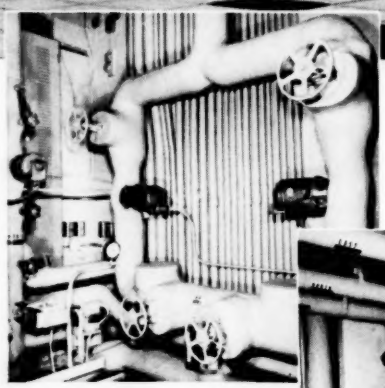
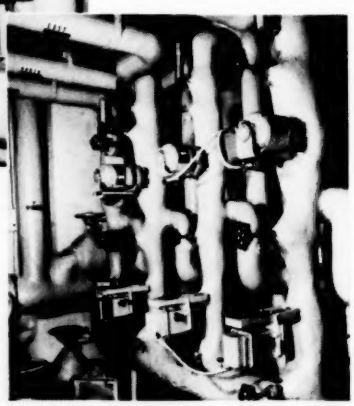
Perkins & Will
General Contractor:
Turner Construction Co.
Mechanical Contractor:
M. J. Corboy Corp.

"ENGINEERED FOR THINKING" ...WITH 22 QUIET B&G BOOSTER PUMPS





B&G Boosters installed in various heating circuits.

B&G BOOSTER PUMP

Hydro-Flo SYSTEM

BELL & GOSSETT
COMPANY
Dept. FW-4, Morton Grove, Ill.
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

International Minerals and Chemical's new administration and research center, Skokie, Illinois, has been described as "engineered for thinking." In keeping with that objective, twenty-two *quiet* B&G Boosters were selected as the pumps for the heating circuits of the four buildings and the snow melting panels.

B&G Boosters and larger Universal Pumps are designed and built specifically for circulated water heating and cooling systems, in which they satisfy the all-important requirement of *silent, vibrationless* operation. Over 3,000,000 are today installed in such systems.

Among the features of B&G circulating pumps are specially built, more costly motors, tested for quiet running...oversized shafts of hardened alloy steel... long sleeve bearings...noise dampening spring couplers...oil lubrication and leak-proof mechanical seals. They can be serviced without removing from the line.

Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8463 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

801ST

How Different Condensing Rates Can Slow Production

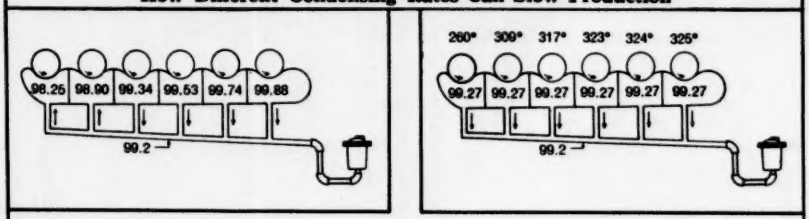


Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

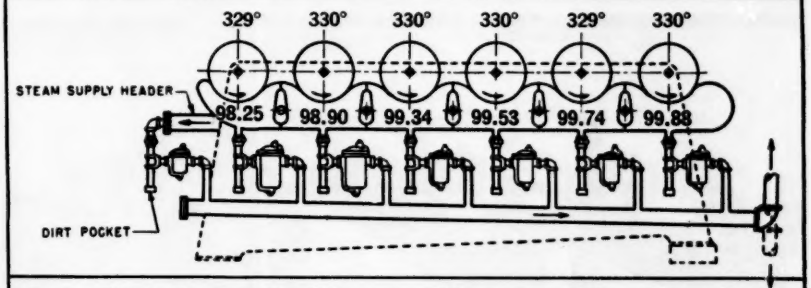
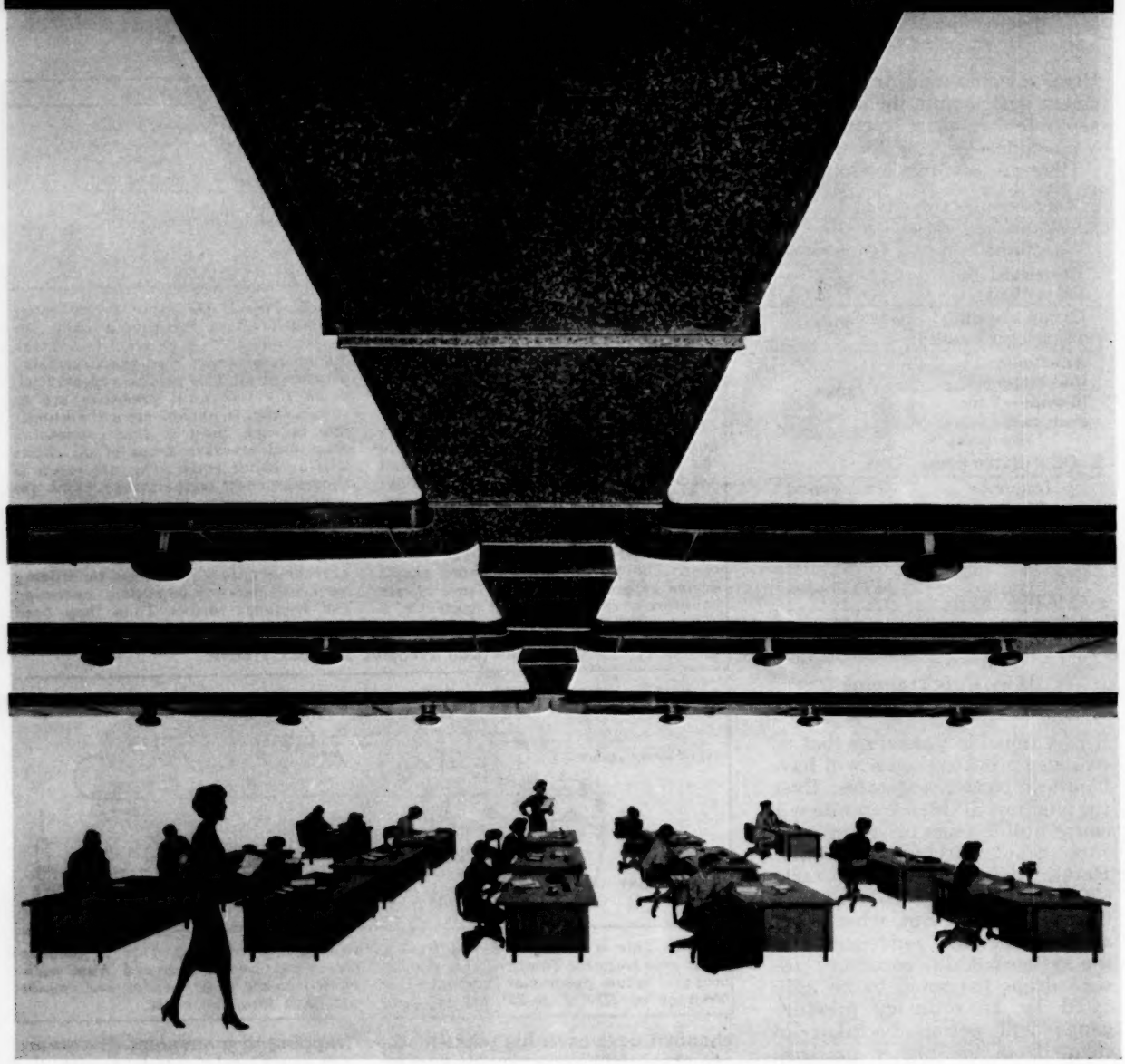


Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

ARMSTRONG STEAM TRAPS

SOFTITE BY WHEELING



Office efficiency by the sheet!

Everybody from building owner to secretary benefits from air conditioning. They all depend upon you to install an effective system. That's one reason why it'll pay you to use Wheeling SOFTITE Galvanized Sheets in all your ductwork.

That's because SOFTITE works easily and smoothly so duct seams are always tight and right. And SOFTITE's galvanized coating never flakes or peels.

Easy to work . . . long lasting and dependable — no wonder our challenge still stands: *Anything that can be made of steel sheets can be made of Wheeling* SOFTITE *Galvanized Steel Sheets.* Accept our challenge! Try SOFTITE and see for yourself! Wheeling Steel Corporation, Wheeling, West Virginia.

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AIR CONDITIONING HEATING AND VENTILATING

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HIGH SPOTS

Two itinerant Eskimos, Kiawak and Eeyeevudluk, are spending a pleasant summer in a life-size plastic igloo thanks to the loan of a 5-ton Airtemp packaged air conditioner by Chrysler Corporation. The two stone-carving stars of an Eskimo exhibit this summer in Stratford, Ontario, Canada, let it be known through their translator shortly after the exhibit had gotten underway that they could not stand the 90-deg climate. Hearing of their plight, Steve Menich, sales manager of Sutherland-Schultz Co., Ltd., Chrysler dealer in nearby Kitchener, got in touch with Therm-O-Rite Products, Ltd., Toronto, the Chrysler distributor. Chrysler's Dayton headquarters was notified and the loan was arranged. The air-conditioned Eskimos are reported very pleased with the whole thing, including the publicity they are receiving through Sutherland-Schultz advertisements, capitalizing on the unique application of the air conditioning equipment.

A special study of school fire safety has been undertaken by the National Academy of Sciences-National Research Council. The study will be conducted by the Building Research Advisory Board (BRAB) with joint sponsorship be the Committee on Fire Research (CFR), two subsidiary groups, under a grant from Educational Facilities Laboratories, Inc., an organization established by the Ford Foundation. Chief purpose of the project is to assemble, evaluate, and publish information on the question of fire safety and its dual relationship to the economics of school structures and the educational needs of communities. The committee is composed of architects, engineers, school and fire protection authorities. Chairman is Norman J. Schlossman, of Loebl, Schlossman and Bennett, Chicago architects.

An Insulation Information Center, for consultation by industry on insulation characteristics, application techniques, and specifications, has been established by the newly formed **National Insulation Manufacturers Association,** 441 Lexington Avenue, New York 17, N. Y. The service will be in charge of John M. Barnhart, association executive secretary, and John C. Parlett, technical adviser and chairman of the association's Technical and Research Committee.

Mr. Barnhart is a former instructor in thermodynamics, heat transfer, heat power, and hydraulics at Rensselaer Polytechnic Institute. Prior to entering association work six years ago, he worked as design engineer for Western Electric Company and the New York Central Railroad. **Mr. Parlett** is a veteran of 40 years in industrial thermal insulation, covering research and development as an engineer, department head, and adviser to the ASTM's committee on thermal insulation.

The new association, which is known more briefly as **NIMA,** represents companies many of which belonged to the now dissolved Industrial Mineral Insulation Manufacturers Institute and Magnesia-Silica Insulation Manufacturers Association. Member companies produce insulations for the full temperature range of minus 460 to plus 1900 deg F.

Research in lead as an anti-vibration material has been initiated by Lead Industries Association, New York, N. Y. Combination lead-asbestos pads have been used for many years to prevent transmission of vibration from railroad tracks to buildings, the association points out. Many buildings along railroad right-of-ways are erected on such pads. These pads are also in use under heavy printing presses, cooling towers, and other machinery. Many engineers have expressed interest in lead for vibration control but have not had available to them adequate design and efficiency data. It is intended to develop these data systematically through the new research project, which will be conducted under contract by Lessells and Associates, Inc., Boston, Mass.

THE ST. LAWRENCE SEAWAY AUTHORITY BUILDING
Cornwall, Ontario

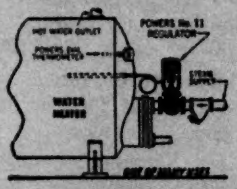
Architects: GORDON S. ADAMSON & ASSOCIATES, Toronto
Consulting Engineers: R. P. ALLSOP & ASSOCIATES LTD., Toronto
Mechanical Contractor: CANADIAN COMSTOCK CO. LTD., Ottawa

Powers Temperature Control Here Includes Solar Compensator System

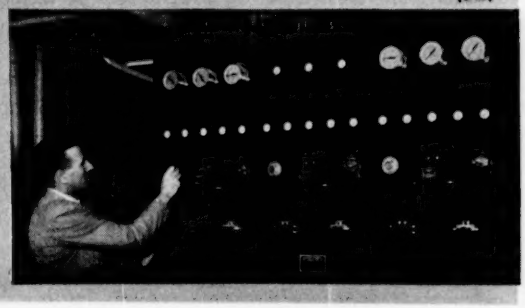
The direct radiation is regulated by a Powers MASTROL System. Controlled conditioned air for intermediate floors is supplied by a central fan system. On the top floor a central supply unit with unit conditioners for individual spaces, is equipped with a solar compensator system. It automatically changes the system from heating to cooling at the optimum condition dictated by outdoor temperature and sun intensity.

Photo below shows Powers Control Center with solar compensator adjustments, gauges, relays, switches and thermometers to indicate operation of the air conditioned zones on the executive floor.

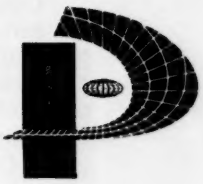
(D15)



Powers No. 11 Temperature Regulator used here for hot water storage heater stops hot water complaints and saves fuel.



In the headquarters of the
"World's Largest Controlled Deep Water Navigation System"



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Once again in another important building a Powers Quality System of Air Conditioning Control provides the utmost in comfort, fuel economy and year after year dependable operation.

Unique in World History

The new St. Lawrence Seaway is an outstanding example of good neighborliness between two nations. Working efficiently together Canada and the United States have expanded an inland sea to strengthen the defense and economy of each nation.

The Seaway begins and ends in Canadian territory. Two-thirds of its cost was paid by Canada and from the tolls collected at the headquarters in Cornwall two-thirds is paid into the Canadian Seaway account, and one-third is paid to the United States Seaway headquarters at Massena, N. Y.

For your new building—remember that successful operation of heating or air conditioning can only be as good as the control system. Make sure you get the best. Insist on a time-proven Powers Control System.

THE POWERS REGULATOR CO.

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Automatic Temperature and Humidity Control Since 1891

WASHINGTON OVERTONES

by LORING F. OVERMAN

● **Contrast was the principal overtone observable in Washington as members of Congress hurried to make the last month of summer also the last month of the current session.**

Contrast was apparent as auto sales boomed; as the steel strike began to make its braking effects felt on related elements of the economy.

Contrast again appeared as housing starts established new records despite tightening mortgage funds as housing legislation lagged.

Contrast—the privilege of individual initiative—posed new problems for Washington officialdom as it planned a "best foot forward" visit for Russia's No. 1 man.

For a closer look:

● **Looking at the first half of 1959 revealed new housing records in sight. Second half of the year promises a slight downturn, but nothing to fear.**

—843,700 new private and public dwelling units had been put in place through July. Figure is up 30 percent over January-July of 1958.

—private total of 822,300 units exceeded private total for the first seven months of 1958 by 215,700 units.

—public housing for the period totaled 21,400, barely half of the 42,200 total during the first half of '58.

—annual rate of privately financed housing through July was above the 1.3 million mark.

● **Contrasting viewpoints in Washington were nowhere more apparent than in the White House-Capitol Hill feud over the housing bill.**

—Hill viewpoint stuck doggedly to the idea of providing Federal funds for special purposes—public housing, urban renewal, college housing, housing for the elderly.

—White House insisted primary function of the legislation is to encourage financing by private building interests. Linking of the two in an omnibus measure making mortgage guarantees dependent upon acceptance of "special projects" brought about the impasse.

—Presstime indications forecast a "less expensive" compromise bill providing for short term "specials" which would have to be debated again at the next Congressional session . . . or at the polls.

● **The possibility that Congress has had enough of labor racketeering was another contrast.** Speculation that any labor legislation passed would be merely a token gesture was shaken when the House passed, by a wide margin, a quite restrictive Landrum-Griffin labor reform measure.

Conversely, the likelihood that a Senate-House conference committee might file away some of the barbs was conceded.

The contrasting viewpoints were felt by some to offer Congress an escape hatch; an adjournment without voting a labor bill, but with a record of "A for effort", whether judged by management or labor.

● **Everyone who drives the highways, or uses space in transport trucks had a stake in another Washington contrast—how to finance the stalling interstate highway construction program.**

Air-conditioning of a growing Suburbia depends upon continuation of the highway program. Yet the addition of the Administration-proposed tax of 1½¢ per gallon of gasoline has met with little enthusiasm.

Contrasting viewpoint of legislators at presstime: 1¢ increase for 22 months; then diversion of highway user excise taxes to the highway trust fund.

(Continued on page 8)

CITIES SERVICE OIL COMPANY — ROMA WINE COMPANY — ALLEN B. DUMONT LABORATORIES, INC — AMERICAN AIRLINES, INC. — GENERAL SERVICES ADMINISTRATION — J. M. FIELDS STORES — U. S. ARMY — FROZEN RITE, INC. — PACIFIC TELEPHONE & TELEGRAPH COMPANY — TEXAS FASTENER CORPORATION — RONEY PLAZA HOTEL — UNIVERSITY OF SOUTHERN CALIFORNIA — PHILLIPS PETROLEUM COMPANY — CHICAGO BRIDGE & IRON — GENERAL ELECTRIC — ATLANTIC & PACIFIC TEA COMPANY — ROBERT HALL CLOTHIERS — HUMBLE OIL COMPANY — OLIN MATHEISON — LOCKHEED AIRCRAFT AREOJET — SYLVANIA ELECTRIC — F. W. WOOLWORTH COMPANY — KAISER ENGINEERING CORPORATION — U.S. NAVY SAFEWAY STORES — CONVAIR — ATOMIC ENERGY COMMISSION — CONTINENTAL BAKING COMPANY — REPUBLIC AVIATION — FOOD FAIR STORES — NATIONAL CASH REGISTER — BURROUGHS CORPORATION — FEDERAL HOUSING ADMINISTRATION — EDISON COMPANY — RAND McNALLY & COMPANY — MINNESOTA MINING & MANUFACTURING BANK OF AMERICA — U.S. AIR FORCE — NEW YORK [illegible] COMPANY — FRANKLIN STORES — NATIONAL FOOD STORES — CENTRAL CASUALTY INSURANCE COMPAN[illegible] COMPANY — PACIFIC GAS & ELECTRIC — RADIO CORPORATION OF A[illegible] KY LAGER BREWING GENERAL [illegible] T STORES SEARS & [illegible] — STATE FARM INS[illegible] - MUZAK CORPORAT[illegible] PORATION BOND STO[illegible] NSURANCE COMPANY [illegible] REFINING COMPANY [illegible] COMPANY NEW ENGLAND TELEP[illegible] LONIAL STORES, INC. GLENN MANUFACTURING COMPANY — CURTIS WRI[illegible] EL MUNDO, INC. — U. S. PLYWOOD — FORD MOTOR COMPANY OF CANADA, LTD. — DIPLOMAT HOT[illegible] ILD CAMERA & INSTRUMENT COMPANY — AMERICAN THERMOS PRODUCTS — PACIFIC MURPHY MANUFACTURING CORPORATION — THE MAYTAG COMPANY — INTERNATIONAL BUSINESS MACHINES — NATIONAL BISCUIT COMPANY — ASIATIC PETROLEUM CORPORATION — INSULAR CHEMICAL COMPANY STANDARD LIFE & ACCIDENT COMPANY — EASTMAN KODAK COMPANY — UNIVERSITY OF OKLAHOMA — BELL AIRCRAFT MONARCH METALS WEATHERSTRIP COMPANY — McDONNELL AIRCRAFT CORPORATION — BETHLEHEM STEEL COMPANY — B-THRIFTY STORES, INC. — WAYNE PUMP COMPANY — ARMA CORPORATION — THREAD, INC. — AMERICAN OIL COMPANY TRANSCON FREIGHT LINES — AMERICAN CAN COMPANY — KANSAS CITY FIRE AND MARINE INSURANCE COMPANY — T G & Y STORES — BRITISH OVERSEAS AIRWAYS CORPORATION — RAND McNALLY & COMPANY — NEW YORK TELEPHONE COMPANY WESTERN ELECTRIC COMANY — AMERICAN MACHINE & FOUNDRY — W. T. GRANT COMPANY — PIGGLY-WIGGLY FOOD STORES J. C. PENNEY COMPANY — PENN FRUIT STORES — RUTGERS UNIVERSITY — U. S. MARINE CORPS — HOWARD JOHNSON'S KROGER COMPANY — CIVIL AERONAUTICS ADMINISTRATION — E. I. DuPONT De NEMOURS & COMPANY — SAHARA HOTEL

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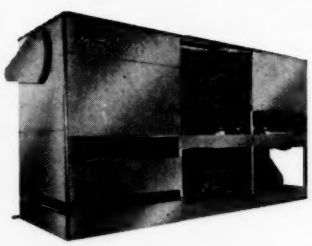
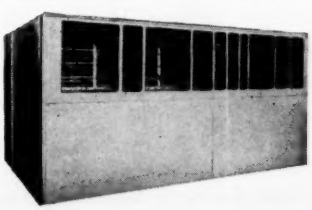


Model SCMZ

Self-contained Multi-Zone air conditioner — one of 18 basic Self Contained equipment models, available from 3 to 120 tons.

Model GMZ

Governair also "Satisfabricates" a complete line of Vertical, Horizontal and Multi-Zone Air Handling Units.



"SATISFABRICATED"©

. . . that's the copyrighted term that describes Governair air conditioning . . . equipment which is so basically flexible in design, that it can be manufactured to fit almost *any* space and load requirement.

This beneficial feature, pioneered and developed by Governair, is coupled with imaginative, tested engineering and quality workmanship. The end result is an installation that's a much *wiser* dollar investment.

Write for detailed information, or consult your yellow page directory for the name of our local representative.

THE GOVERNAIR CORPORATION

4840 N. SEWELL • OKLAHOMA CITY

WASHINGTON OVERTONES *(Continued from page 6)*

● Speaking of taxes:

—Internal Revenue Services has approved, in a list of items for retail food stores, a schedule of the useful life of air conditioners. Systems rated from 5 to 15 tons are assigned a useful life of 15 years, for tax depreciation purposes. Systems over 15 tons have an estimated life of 20 years.

—The estimates, given by IRS in a letter to an association of retail grocers, are not listed in the Bureau's official depreciation guide, Bulletin "F".

—The lives shown in the letter are averages generally acceptable to the Revenue Service. Permitted are variations based on operating conditions, experience, and repair-replacement policies.

● **Washington continued, at presstime, to minimize officially the effects of the lengthening steel strike.** The principal contrast is the fact that, with supplies largely arrested, built-up inventories permit near-normal end-use.

—Oil and gas industry, for example, reports no pinch up to deep August. October 1 was mentioned as a date when, if the strike continues, reserve stocks might be dwindling.

—For the moment it appears that those who heat, cook, or power with oil or gas have little to fear from the steel strike.

● Assuming continuation of the steel strike into September, the contrast of an idle industry and a booming manufacturing economy may well prove as puzzling to Russia's No. 1 visitor as it is to many Washington economists.

Business forecasts for 1960, anticipate a gross national product above $515 billion. Involved, the forecasters say, is a jump in capital spending and in installation of equipment; also auto sales above the current rate of 6.3 million.

Home-building may level off at bit—a contrast from most principal industries—but the drop-off would be minor.

The answer to the Russian visitor will probably point out that America's strength, businesswise and otherwise, echoes the prosperity of the individual. Thus, despite a blind spot here and there, America's millions have work to do, money to spend, and the freedom to go farther and faster.

● **How times change in the field of heating and ventilating is revealed in a recent report of the National Industrial Conference Board.**

—Report points out that coal, which supplied 90% of the nation's energy in 1900, now provides less than 30%.

—Crude oil and natural gas accounted for only 5% and 3% respectively, but last year had risen to 37% and 31%.

—Production of energy from all American sources, the report stated, was five times the total 60 years ago.

● If there's a shortage of oil some of these days, it won't be because ocean-going tankers aren't getting bigger and bigger. Latest authorized is a 106,000 ton tanker to be constructed by Bethlehem's Quincy, Mass. yards. Two "small" tankers—46,000 tons each—are also approved under a Title XI loan approved by the Maritime Administration. The larger vessel will be 940 feet long, with 132-foot beam and will have 5,109,250 cubic feet of cargo space. Estimated speed at 43,000 horsepower, is 17.5 knots.

● **Another Washington contrast: House Subcommittee on Census and Government Reports heard testimony from company comptrollers complaining about multiplicity of reports required by Government.** Additional testimony indicated the information was being collected for use by and at the request of sales managers of the same companies employing the comptrollers. House Committeemen heard that the sales people find the information valuable in charting sales programs.

4-D WROUGHT IRON STEAM RETURN LINES

STEAM CONDENSATE CORROSION: the cause, the effect, and a suggested safeguard

4-D represents the most significant development in the history of wrought iron metallurgy. It was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate. Result is increased corrosion resistance, improved mechanical and physical properties.

Write for new 4-D Wrought Iron literature and our special report, The Use of Wrought Iron in Steam Condensate Lines. A. M. Byers Company, Clark Building, Pittsburgh 22, Pa.

WHAT CAUSES STEAM CONDENSATE—Steam, losing its heat, turns to moisture as temperature drops below saturation level. This condensate is distilled water, greedy for gases. Any gas in the steam is readily absorbed into this condensate as it cools. The condensate becomes violently corrosive to ordinary piping materials, depending upon the percentage of free CO_2 plus O_2 in the steam.

EFFECT OF STEAM CONDENSATE ON PIPE—Carbon dioxide is the primary cause of return line corrosion. Like oxygen, carbon dioxide is present in all raw waters and may enter the boiler with the feed water. Most of the carbon dioxide found in the steam cycle results from decomposition of the bicarbonate or carbonate content of the boiler feed water. Build-up of insoluble products of corrosion—particularly in smaller lines—may plug the pipe and render it useless. Corrosion may cause grooving, channeling, pitting, completely penetrating the pipe wall.

A PIPING MATERIAL THAT COMBATS IT—New 4-D Wrought Iron is a two-component metal consisting of high purity iron and iron silicate fibers. There are over 250,000 non-rusting glasslike fibers to every cross-sectional square inch. The purity of the iron itself, plus the protection of the iron silicate fibers are a mighty formidable deterrent to steam condensate corrosion and its deleterious effects.

BYERS 4-D WROUGHT IRON

NEWS OF THE MONTH

ALL-ALUMINUM COILS

for air conditioning are being field tested by manufacturers. Zinc soldering key to success.

All-aluminum coils for air conditioners today are on the brink of acceptance by many manufacturers, according to Aluminum Company of America, Pittsburgh, Pa.

Aluminum alloys and design techniques now are available to meet virtually all operating conditions, the company states, and, as a result of Alcoa recommendations, three major manufacturers currently are field testing more than 3,000 units equipped with all-aluminum coils.

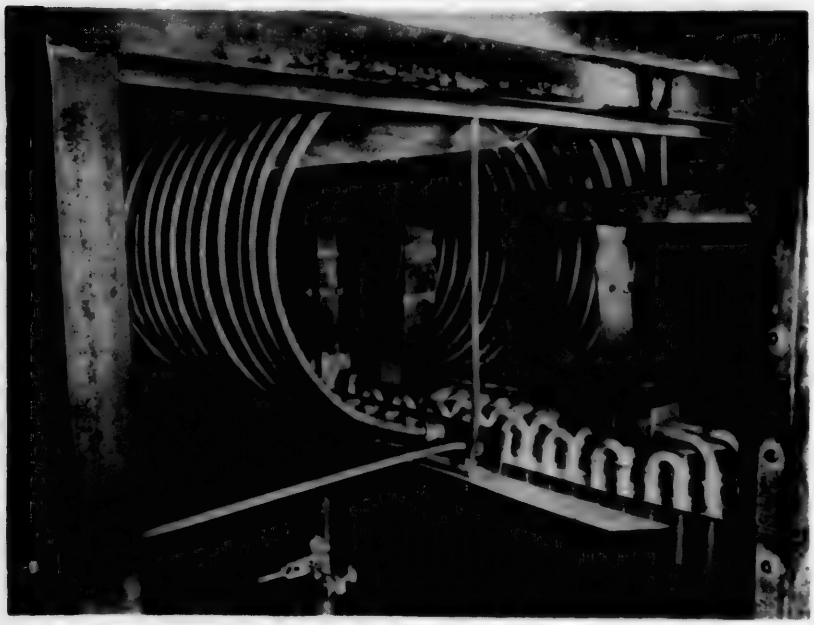
All-aluminum coils were first tried in the early 1950's. However, alloys and design techniques then available proved inadequate for corrosive conditions experienced in some environments, and air conditioner makers shelved the aluminum coil idea.

The company conducted controlled service tests of various aluminum designs in evaporator and wet condenser coils — made in three environments more corrosive than those encountered in normal service— which convinced its engineers that properly designed aluminum coils will perform well. The second development was the perfection of a zinc soldering process for successfully joining aluminum to itself, or to other metals.

In the unsuccessful earlier commercial venture with aluminum coils, it was discovered that copper components had been located in proximity to aluminum parts. Sample condensers from these units provided confirming evidence that corrosion of aluminum had been accelerated by electrolytic action between the two disimilar metals. Therefore, company engineers redesigned several air conditioners to achieve a minimum of copper components. Aluminum was substituted for copper wherever possible. Where copper and aluminum required joining, the zinc soldering process, utilizing specially developed joining products, was employed.

Air conditioners of different designs then were tested for two years at three widely separated U. S. locations. According to Alcoa, the tests demonstrated that aluminum can be used successfully for coils and for other air conditioner components.

The most effective designs evaluated in the controlled tests incorporated either the more corrosion-resistant Alclad alloy tube, or protection of the tube by anodic aluminum-alloy fins and suitable paint coatings on the exposed tube of the wetted condenser coils.



A flame soldering technique, utilizing fluxes and solders developed by Aluminum Company of America, is used to assemble all-aluminum coils for home air conditioners. The coils now are being field tested in more than 3,000 locations in the United States. Photo courtesy Airtemp Div., Chrysler Corp.

BRI MEET

to feature sessions on curtain walls, sandwich panels, reports from abroad, heating techniques.

Building Research Institute, National Academy of Sciences-National Research Council announced that the first of its new multi-subject conferences to be held Nov. 16-19 in Washington, D. C. at the Shoreham Hotel, will include subjects intended to interest anyone associated with the development of building science.

Already scheduled are discussions and full-scale workshop sessions on sandwich panel design, architectural metal curtain walls, building research in the United States and overseas, and the problems of manufacturers whose products are used in component construction, among other subjects. Agenda and program procedure will be patterned after BRI's successful Eighth Annual Meeting in Pittsburgh last April.

Dr. Albert Dietz, of MIT, will head three-days of sessions on "Sandwich Panel Design Criteria," during which leading specialists will read papers on fundamentals of panel design and present case histories of new designs, including vertical and horizontal panels for interior and exterior application. Five

(Concluded on page 12)

And in Oakland — A FUTURE OF FAULTLESS SERVICE

Fronting on Lake Merritt in downtown Oakland, the West's largest office building will provide international headquarters for the more than 50 affiliated Kaiser Companies...and, in accordance with carefully written specifications, will be serviced by over 500 DELANY flush valves. This $45,000,000 complex for 4,500 employees will be dominated, upon completion in late 1959, by a twenty eight floor aluminum and glass office building with a graceful, curved design. Four acres of landscaped gardens will roof over a five level parking garage, a 400 seat auditorium, banquet accommodations, and quality shopping facilities. All flush valves in Kaiser Center will be concealed in access boxes. Routine repairs will be somewhat more time consuming and hence the installation here of ruggedly efficient DELANY flush valves is particularly apt. The ever swelling demand is for DELANY—"the fastest growing name in flush valves!"

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(Concluded from page 10)
separate workshops will analyze design criteria for exterior load-bearing and interior non-load-bearing walls, partitions, floors, ceilings and roofs.

Sessions on "Building Research" will occupy two conference days. Speakers will include BRI members who attended the International Building Conference (CIB) in Rotterdam with reports on research developments in Russia, Scandinavia, Holland, the Far East, etc.

Also on the agenda for the building research section of the conference will be sessions on methods for promoting intra-industry research into problems arising from the use of many different products in one construction component or in multiple-product assemblies; current advances in the documentation of building science literature and its classification, indexing, and organization; and building research at universities, colleges or private research laboratories. A full day will be devoted to consideration of architectural metal curtain walls. New curtain wall buildings to be presented as case studies include a research center, two office buildings, a high school, public library and hotel.

Other segments of the conference program will be concerned with new heating techniques, and possibly, the maintenance of industrial buildings.

Conference sessions will be open to the public. Complete program and registration material may be obtained by writing Harold Horowitz, Asst. Director for Technical Programs, Building Research Institute, 2101 Constitution Avenue, Washington 25, D. C.

ACCUSE AUTO INDUSTRY

of reneging on pledges to work for reduction of exhaust fumes. Dr. Greenburg new APCA proxy.

The Automobile Manufacturers Association, and the auto industry generally, were roundly censored at the fifty-second annual meeting of the Air Pollution Control Association in Los Angeles for dragging their feet on efforts to control automobile exhaust fumes. These fumes are said to be a major source of air pollution in large industrial cities and a major component of smog.

About 1,000 engineers and administrators attended the five-day convention. Dr. Leonard Greenburg, commissioner of air pollution control of New York City, was named president of the association for the coming year.

Leading the critics were Smith Griswold, director of the Los Angeles County Air Pollution Control District, and Warren Dorn, a member of the Los Angeles County Board of Supervisors.

According to Mr. Griswold, auto industry representatives had assured local officials only a few months ago that they were trying to expedite development of exhaust controls, but needed more basic knowledge. Shortly afterward, Mr. Griswold stated, the industry withdrew from participation in the convention, a major forum for pollution information, with the excuse that they did not care to come to Los Angeles where they were unfairly criticized.

They have been making excuses since 1956, he continued. The only device they have developed so far has failed, when tested, to measure up to the levels of efficiency claimed for it.

Mr. Dorn pointed out that the people of Los Angeles spend a billion dollars a year on automobiles, yet the auto industry spends only one million dollars, or one percent of this on research in smog prevention, "hardly the crash program demanded by the people of this county as well as the people of nearly every other metropolitan area of the country." He cited in contrast the local industry outlay of between $70- and $100-million, and the taxpayers' expenditures of $17-million in the past twelve years in addition to Los Angeles' $4-million annual budget for smog abatement.

SEWER PIPE RULING

invalidates proposed restriction to extra-heavy cast iron. Fiber pipe manufacturers brought suit.

Fiber sewer pipe is satisfactory for use in Milwaukee, Circuit Judge Ronold A. Drechsler ruled. He declared that the "heavy cast iron pipe" rule of the city and metropolitan sewage commission was as unconstitutional as it was monopolistic.

The rule, originally scheduled to become effective November 1, 1958, specified exclusive use of "extra-heavy cast iron soil pipe with hot poured lead joints" for all home or building sewers "connected to sanitary or combined sewers." A temporary injunction was obtained from Judge Drechsler by five fiber pipe manufacturers to prevent enforcement of the rule. The trial to test the rule's validity commenced before Judge Drechsler in March.

In his decision Judge Drechsler said, "A number of house sewer installations of bituminous fiber pipe have been made, and are being made in the City of Milwaukee, in the district, and elsewhere in Milwaukee County, without complaint. Such pipe, under certain conditions, if properly installed and not abused, meets requirements for home sewers, at less cost than extra-heavy cast iron soil pipe with hot poured lead joints. It has some qualities which are superior to cast iron soil pipe, such as its resistance to corrosion and deterioration under certain soil conditions in the district.

"Upon the evidence in this case, this rule which limits all home sewers, regardless of unfavorable soil conditions, therefore, to extra-heavy cast iron pipe, is unreasonable, arbitrary, beyond a reasonable doubt, and invalid. It would require the laying of such cast iron pipes in corrosive soils and fill materials, and replacing such a pipe which has become defective because such conditions with the same kind of pipe. The evidence has clearly established that there is enough of such unfavorable soil in the district to be a substantial element to be provided for."

EASY TO HANDLE. Mechanic easily connects a length of 6-inch copper tube. More than 16,000 pounds of Anaconda Copper Tube, Type M, in sizes up to 8 inches, was used for the sanitary drainage systems. Architect and Engineer: California State Division of Architecture. Mechanical Engineer: Division of Architecture. General Contractor: Robert E. McKee, Inc., Los Angeles. Plumbing Contractor: E. O. Nay, Inc., Pasadena.

COMPACT COPPER SANITARY DRAINAGE SYSTEM GIVES NEW CALIFORNIA HOSPITAL MORE USABLE SPACE

CLOSE WORK LIKE THIS is possible only with copper tube. Water and drainage lines hug the ceiling, giving ample basement headroom. Even in tight quarters, connections are easy to make. Sizes in this photo range from ¾" water lines to 4" for drain and vent lines.

Copper tube sanitary drainage lines in the hospital building and administration wing of the new Fairview State Hospital at Costa Mesa, California, eliminated wasted space in furred areas and allowed ample headroom in the basement. Equally important to the project owners, however, was the fact that copper tube drainage systems are easier to install, are long lasting, require less maintenance than other materials.

Copper tube was used also for the hot and cold water lines and for the radiant heating system.

TREND TO COPPER "The factors important to us as mechanical contractors are the work-saving features of copper tube. It has proved to be easier to handle, more adaptable to space problems, less trouble to test, and as a consequence, faster to install than other methods considered standard." B. J. Sabin, Manager, E. O. Nay, Inc., plumbing contractor on Fairview State Hospital.

Specify Anaconda Copper Tubes and Fittings — Types K and L for water supply and heating lines; Type M and the new lighter weight Type DWV for sanitary drainage systems. Anaconda wrought and cast solder-joint fittings for pressure and drainage applications. Write for Publication C-33. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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CORROSION RESEARCH

Since metals were first used for industrial purposes, man has waged constant warfare against the forces of corrosion. This complex process has been defined as the destruction of a metal by chemical or electrochemical reactions with its environment, and deterioration often proceeds in direct proportion to the aggressiveness of the environment. Essentially, corrosion is process metallurgy in reverse. Iron, for example, occurs in nature generally as oxides or hydroxide, and is refined to the steels of structural use. When exposed to a corrosive environment, the metal tends to revert to these original forms, which are then called "rust."

Corrosion is a serious and costly aspect of the Nation's economy. The continuous depletion of ore reserves is only one factor to be considered. Wages, and "down time" of equipment, and replacement costs must also be taken into account. It has been estimated that the annual cost of corrosion in the United States runs to billions of dollars. Of course, exact figures on the total cost are not available, but in the underground pipeline industry alone reliable estimates show the expense of replacement to be about 600-million dollars a year.

To aid in the solution of this problem, the National Bureau of Standards has for many years conducted a program of research on the fundamental mechanisms of corrosion and the corrosion properties of materials. Now under the direction of G. A. Ellinger, this program emphasizes basic processes and principles, seeking to discover why metals corrode and how corrosion can be prevented. Current studies deal with such topics as the corrosion reactions at the metal surface, electrochemical polarization and other electrical phenomena associated with corrosion, the effects of free radicals on metals at low temperatures, the nature of corrosion in large single crystals, and the mechanism of stress-corrosion cracking. By attacking the problem from these various directions, the Bureau hopes not only to improve methods of combating corrosion, but also to obtain basic data on the properties of matter that may be useful in other fields.

Single Crystal Studies. As the corrosive process is influenced by many factors, a study of metals in their commercially usable state affords little information on the fundamental nature of the process. Such information can best be derived by studying the least complex form of the metal that has the basic characteristics of the whole; that is, metal in the form of single crystals. In this way, many of the corrosion-influencing factors of polycrystalline materials can be isolated, and reproducible results can be obtained.

Single crystals are being used in research initiated at the Bureau in 1955 under the sponsorship of the Corrosion Research Council. Chosen to investigate the absorbed layers that form on metal surfaces was the metal-water-oxygen system. Copper was selected as the metal because it has a face-centered cubic structure, is readily available in high purity, and the corrosion products formed are few and simple.

Spherical specimens were initially employed in this work because they permit all of the crystallographic planes to be studied simultaneously. When carefully cleaned and polished specimens are exposed to water containing oxygen, different oxide interference colors appear on the various planes. Each color, readily identifiable from the patterns that are formed, indicates a different rate of growth of the corrosion products.

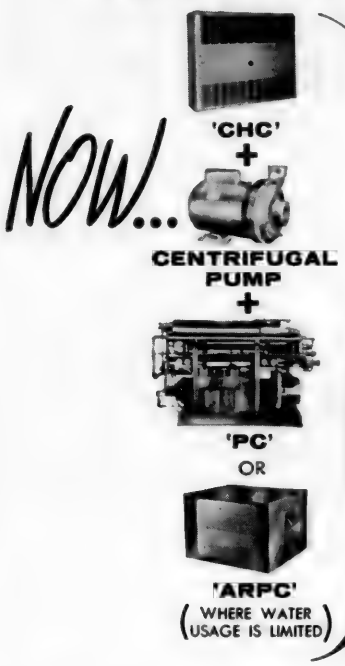
Galvanic Corrosion. Even the purest metals have many foreign atoms within their lattices. Less pure metals contain non-metallic inclusions, metallic impurities, and other inhomogeneities. Exposure to a corrosive medium of dissimilar metals in contact with each other, or of a metal with surface inhomogeneities causes galvanic (electrochemical) corrosion. Such corrosion can also accur on metal surfaces exposed to non-uniform electrolytes with variations in electrical conductivity, etc. The electrical current associated with corrosive action causes the metallic area with the more anodic solution potential to dissolve, forming a pit in the metal surface. The depth of pitting depends on the amount of current that flows from anode to cathode, which in turn may depend on several factors such as anode-to-cathode area, environment, temperature, and pressure. When the mechanism that causes the first pit to form can be determined, a great advance will have been made in understanding the corrosion process.

Galvanic corrosion which occurs on a continuous metallic surface cannot be measured directly. However, the Bureau has developed a method for evaluating this corrosion indirectly, on ferrous surfaces at least. In this method, the currents associated with the changes-in-slope in current-potential curves that occur during cathodic and anodic polarization are measured, and the values of applied polarizing current thus obtained are used to calculate the equivalent corrosion current. This indirect technique has been successfully applied in measuring the corrosion rates of steel in low-resistivity soils and in salt water. A variation of 10% in corrosion rate can be detected in this way.

One galvanic corrosion study deals with criteria for the cathodic protection of metals, principally ferrous metals. Although cathodic protection is based on well-founded scientific principles, its application has been the subject of considerable discussion. Insufficient negative potential gives inadequate protection, yet maintaining a greater potential than is required is unnecessarily costly. In investigating the problem, Bureau scientists have made a series of electrical measurements to evaluate this criteria of cathodic protection.

In a part of this work it was found that steel exposed to soil environments varying in pH between 2.9 and 9.6 can be protected from corrosion by maintaining the steel at an electrical potential of -0.77 volt relative to a saturated calomel reference cell. Recent laboratory experiments showed that -0.77 volt is also the optimum potential for protecting steel in salt water.

COOLING HEATING CONDITIONER



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The new "CHC" Cooling-Heating Conditioner continues the Dunham-Bush pattern of product progress providing "one-source-one responsibility" for all your air conditioning, heating, refrigeration and heat transfer needs.

"CHC" is a compact fan coil unit for mounting between-the-studs of a wall structure, designed to meet the smaller space and capacity requirements of motels, hotels, apartments and residences. Together with Heat-X Package Water Chillers, Dunham-Bush Pumps, and Water Savers, all the necessary equipment to meet complete specifications are provided.

Dunham-Bush "CHC" units are available in two basic sizes—Model CHC-150 and CHC-300. The standard unit is basically designed for free standing use readily adaptable for semi-recessed applications. Each standard unit can be wall mounted, fully exposed or semi-recessed, as required for "off the floor" installations. Matching trim pieces are available for finishing purposes on semi-recessed applications.

Other available features include fresh air wall boxes to meet ventilation requirements calling for the introduction of fresh air up to 20% of the rated CFM: rear discharge sections and grilles to permit discharge of up to 50% of the rated CFM to adjacent rooms where the standard unit is installed on a common interior partition.

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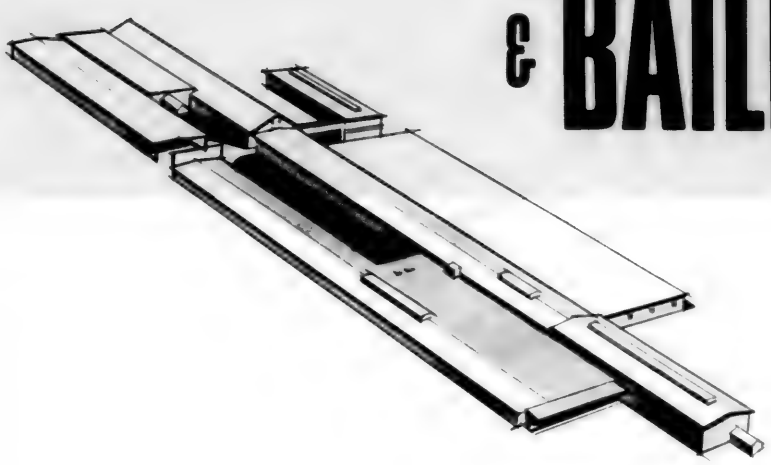

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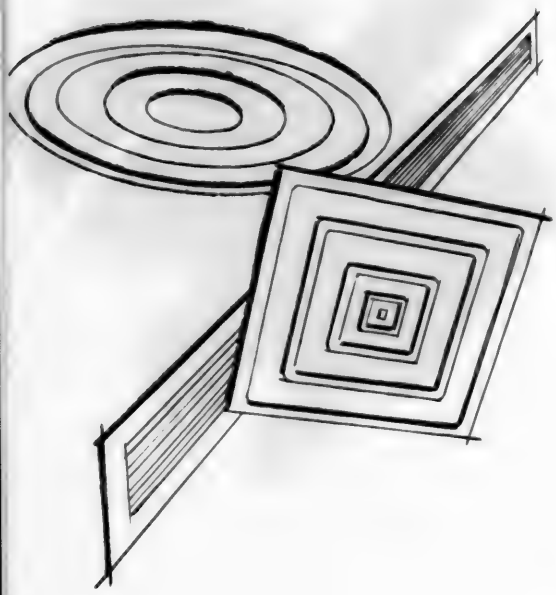
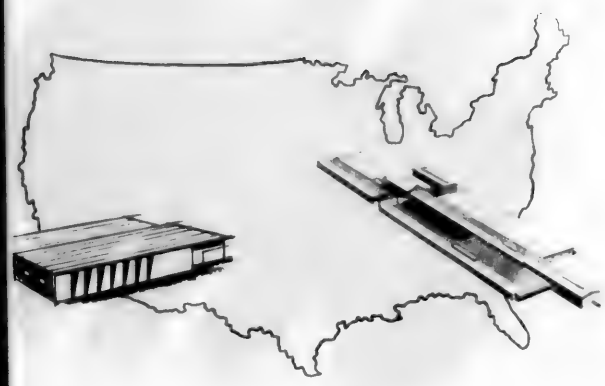


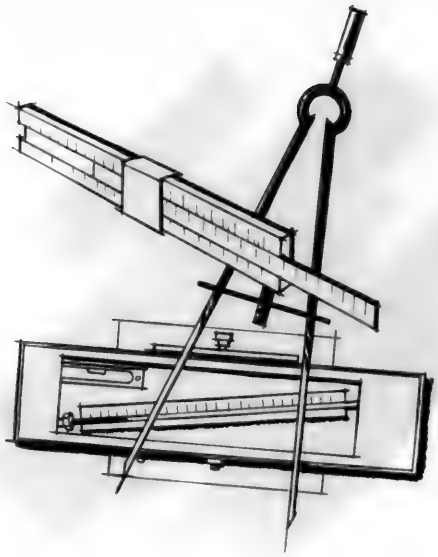
Scope of product lines, manufacturing and research laboratory facilities, nation-wide distribution, product acceptance—these are the areas in which Tuttle & Bailey has established a unique position of leadership in the air distribution industry.

As the first and largest full-line manufacturer, Tuttle & Bailey has pioneered a broad range of air distribution devices and accessory equipment for heating, cooling and ventilating. Until a few years ago, these products were primarily designed for low pressure systems. However, with the advent of high pressure systems, Tuttle & Bailey was one of the first to recognize its significance and is now a leading producer of high pressure attenuation units and related equipment.

To meet the ever-expanding market, Tuttle & Bailey maintains complete manufacturing and laboratory facilities on the East and West Coasts, and is the only company in the industry with plants so situated. In both locations, streamlined production methods, skilled supervisors and workers, the most modern high-speed production machinery and an effective quality control system combine to provide customers with consistently top quality products, efficiently produced and competitively priced.



Meeting the immediate needs of the present—and anticipating the needs of the future as dictated by constantly changing building design concepts—are the projects that keep T&B's large, well-equipped laboratories busy. Engineers, rich in field experience as well as theoretical training, work with the latest test equipment and instrumentation. Ample space permits construction of mock-ups to simulate actual

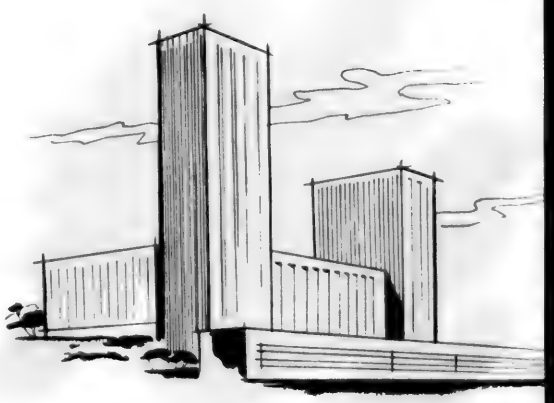


job conditions for the pre-testing of system design and equipment to insure installations that will perform with maximum efficiency.

Representatives, strategically located in principal cities, offer the services of engineering and sales personnel fully qualified to work closely with architects and engineers in helping to solve air distribution problems. With a full knowledge of Tuttle & Bailey products and their applications, they have the background and experience needed to recommend the types of equipment best suited to a particular job. . . and to follow through on every installation detail. In addition, many offices have warehouse stocks of low pressure distribution devices in standard sizes that will meet the majority of job requirements. The names and addresses of these Factory Offices and Sales Representatives are listed on the next page.

Evidence of the acceptance of Tuttle & Bailey products is the impressive list of T&B installations in many of the nation's outstanding office buildings, department stores, schools, commercial and recreational buildings, institutions and industrial plants. From experience, the leading architects, consulting engineers and mechanical contractors—the men responsible for specifying and installing these systems —know that T&B air distribution equipment is designed and engineered to meet their highest standards of appearance and performance, two factors that must always be present to insure owner satisfaction.

Thus, in breadth of lines, manufacturing and laboratory facilities, nation-wide availability and acceptance . . . this is Tuttle & Bailey.



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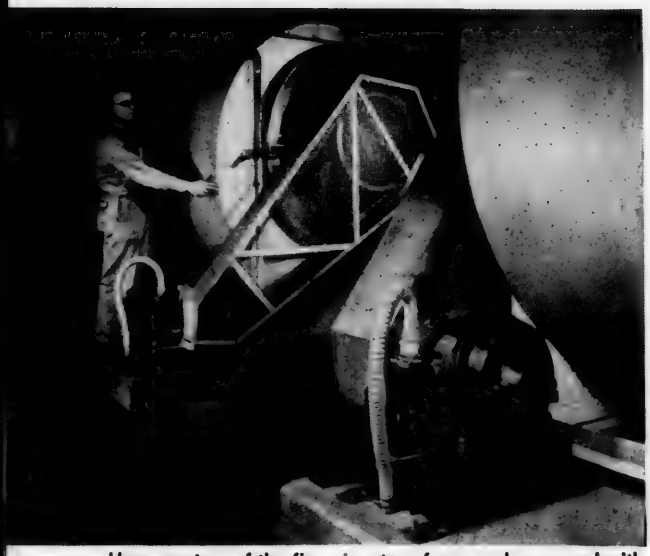

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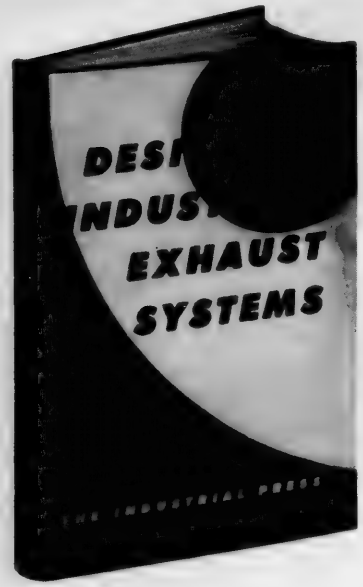

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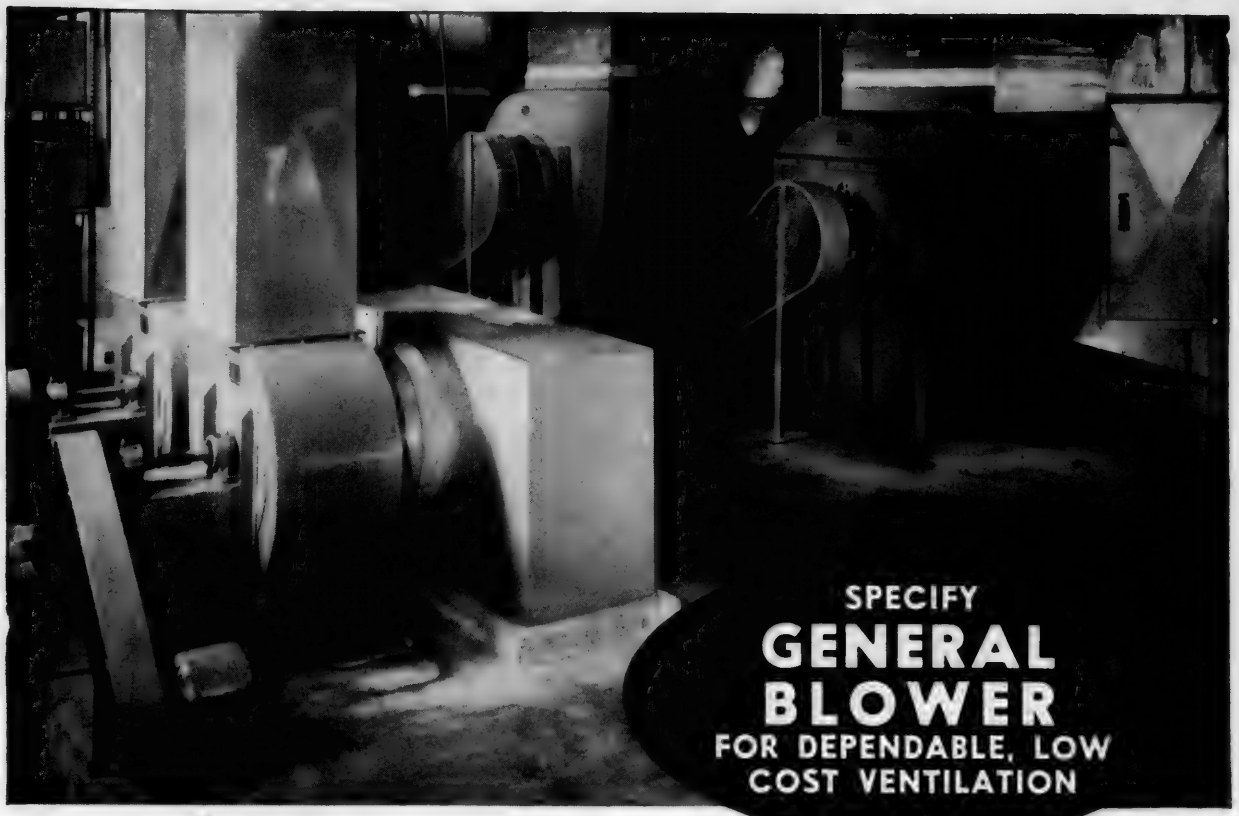

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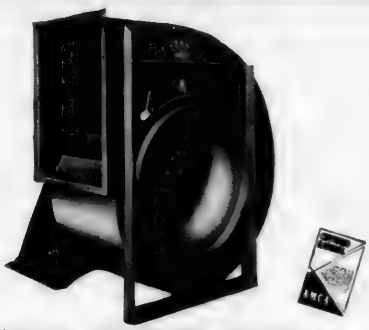

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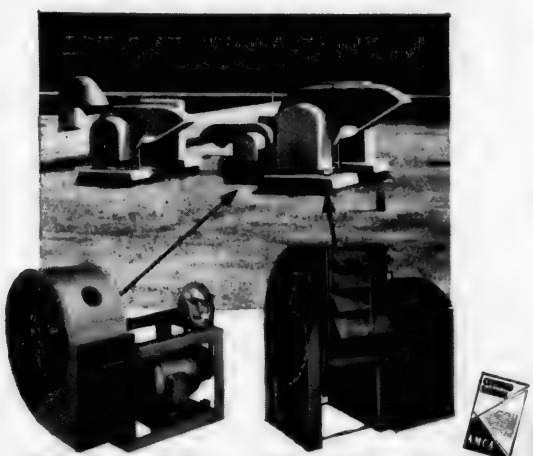

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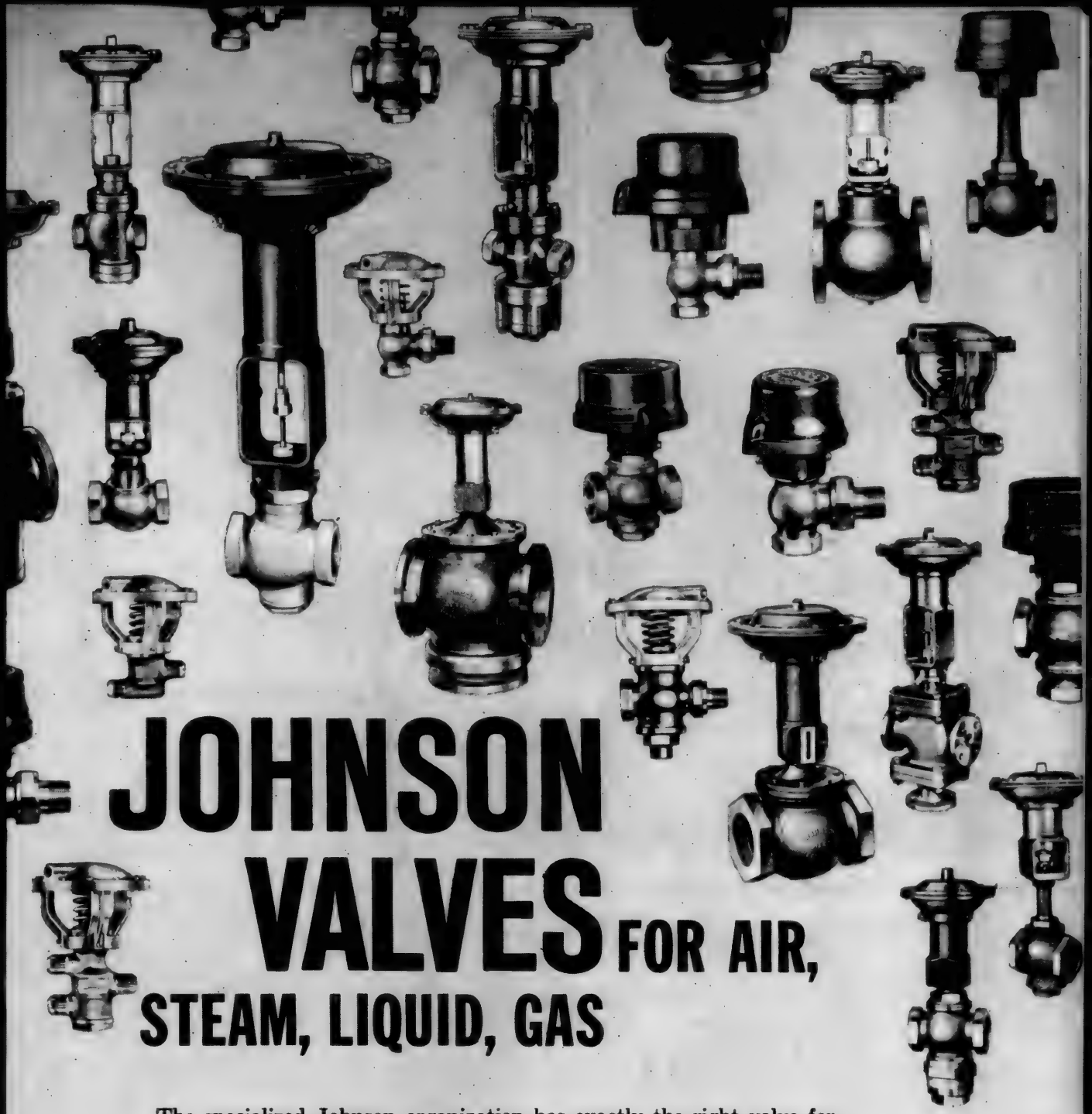

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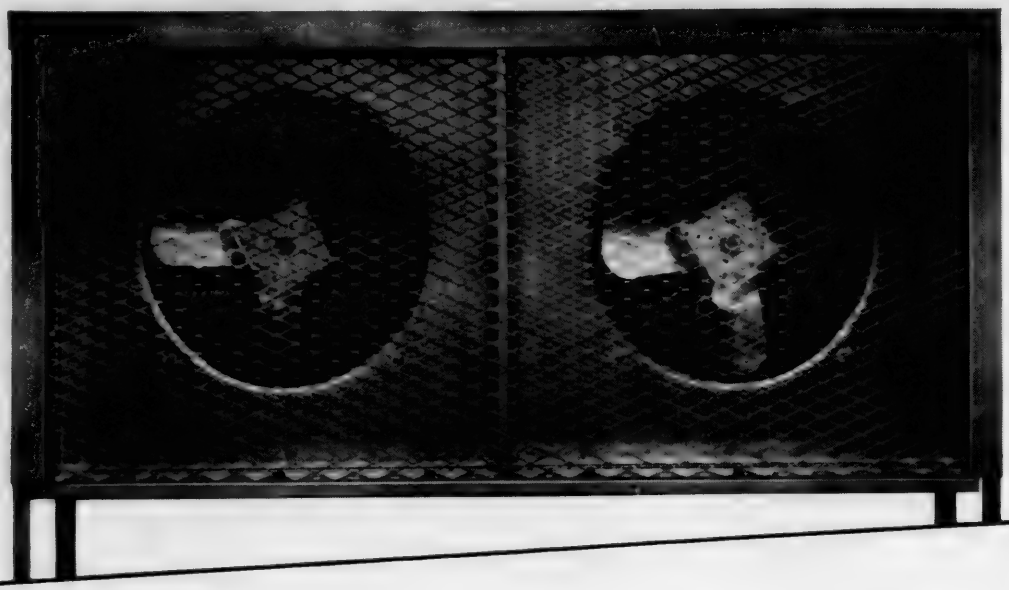

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Note the unit shown here. Powerful direct drive fans, which move larger quantities of air evenly across the entire face of the coil, utilize full condenser capacity.

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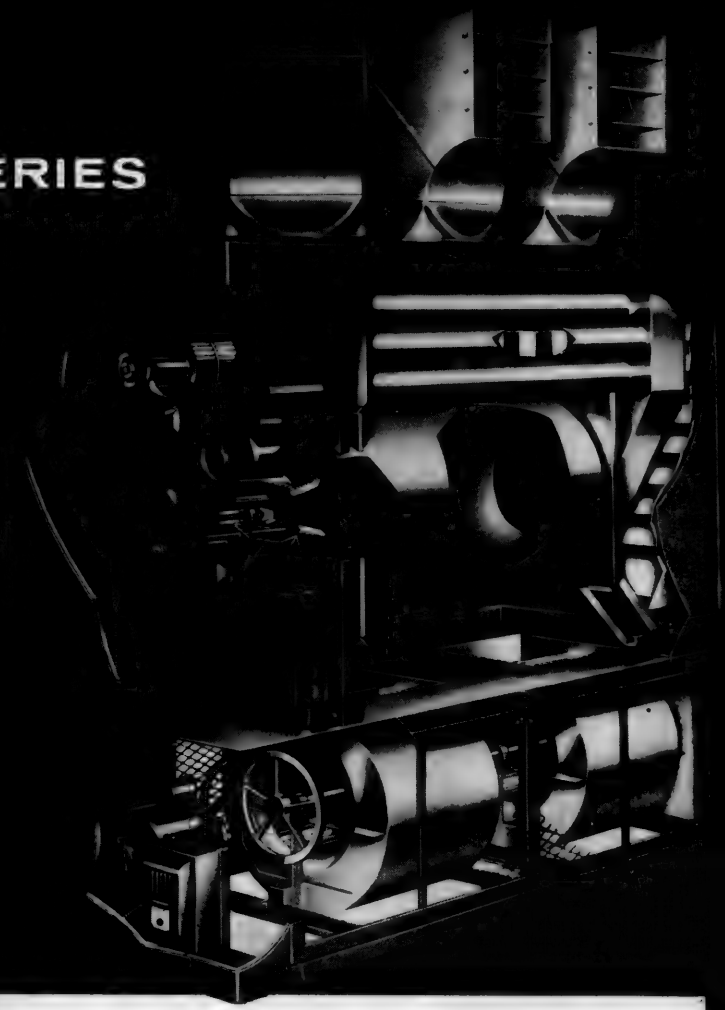

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Here is a completely new type of power burner obtainable as a straight gas burner, a straight oil burner, or a combination burner for either gas or oil. For the combination burner, gas and oil are introduced at two separate points in the same firing assembly. To change from one fuel to the other, you simply throw a switch and it is unnecessary to make any further adjustments.

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3. Pilot is spark ignited and must be proven within five seconds by lead sulfide scanner.
4. When pilot is proven, the main gas or oil valve opens.
5. There is now a 10-second trial for ignition period which is also monitored by the scanner. Pilot flame is then extinguished.
6. If ignition fails, main burner shuts down immediately.
7. Main flame is continuously monitored.
8. When the thermostat is satisfied, main valve shuts off. Combustion and induced draft blower continues to run for 30 seconds providing a post-purge period.

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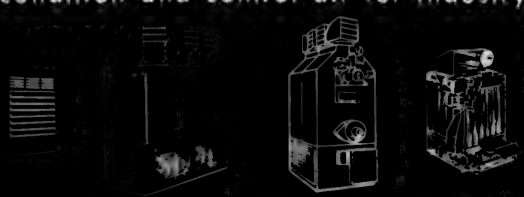

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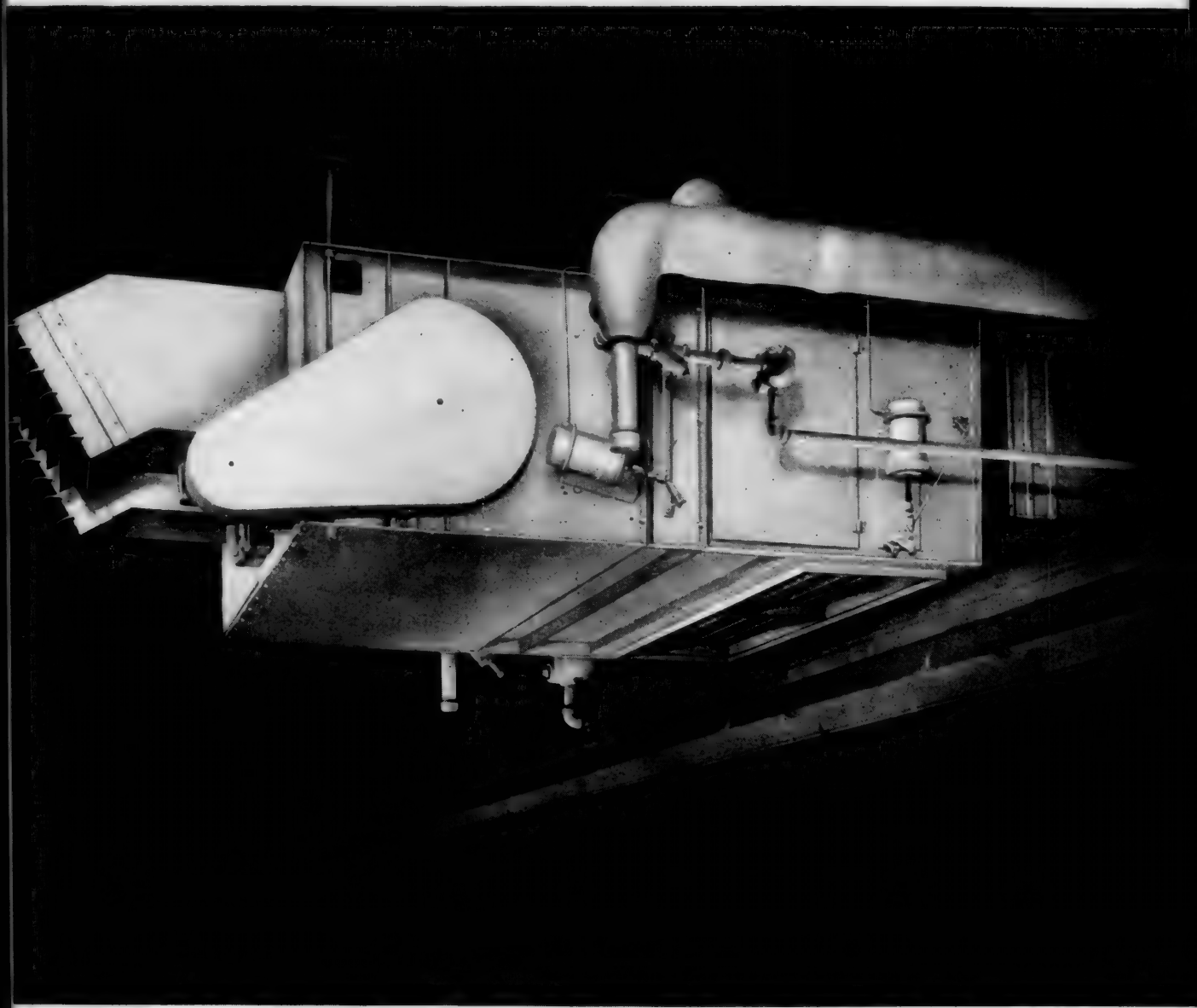

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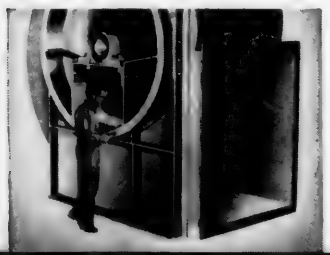

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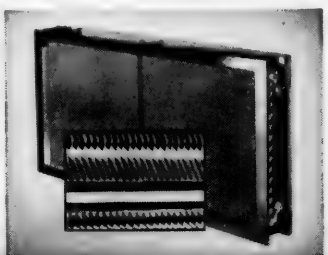

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So when you plan, remember that TRANE equipment is *matched* equipment: designed and built together to work together! Whether it's a unit heater for a doorway or equipment for a complete heating-ventilating system, TRANE product lines are complete in every respect.

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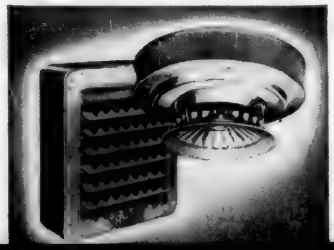

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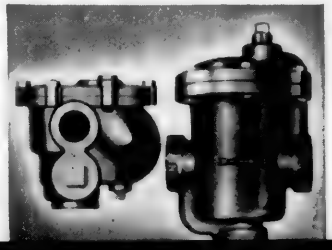

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LESS NOISE **because steel does not expand and contract as much as other materials.**

MORE VERSATILE **than comparable metals. Can be formed into spiral pipe, is readily soldered or welded right on the job.**

MORE ECONOMICAL **both in material and installation costs. Savings run as high as 30 pct over competitive metals.**

Bethcon sheets are the product of Bethlehem's continuous galvanizing lines. They are strong but ductile; rigid but workable; rich-looking yet low in cost. Make your next heating, ventilating or air conditioning job a Bethcon job.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

FOR MOVING HEAT TRANSFER LIQUIDS...

RELY ON "BUFFALO" HIGH TEMPERATURE PUMPS

These pumps are designed especially for handling high temperature liquids. The following description will help you evaluate the suitability of these pumps for this specialized service.

In addition to these special features, "Buffalo" High Temperature Pumps bring you the famous "Buffalo" hydraulically efficient impeller and casing design. Accessibility, dependability and long, maintenance-free life are important *extra* values in every "Buffalo" Pump.

Whatever your heat transfer problem — including vapor phase — phone your "Buffalo" engineering representative for full information.

Only "Buffalo" Pumps bring you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

Water Cooling Bearings and Stuffing Boxes
Special Packing Mechanical Seals are Available
Smothering Gland
Flexible All-Steel Coupling
Colmonoy-Coated Shaft Sleeve Thru Stuffing Box.
BUFFALO PUMPS
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

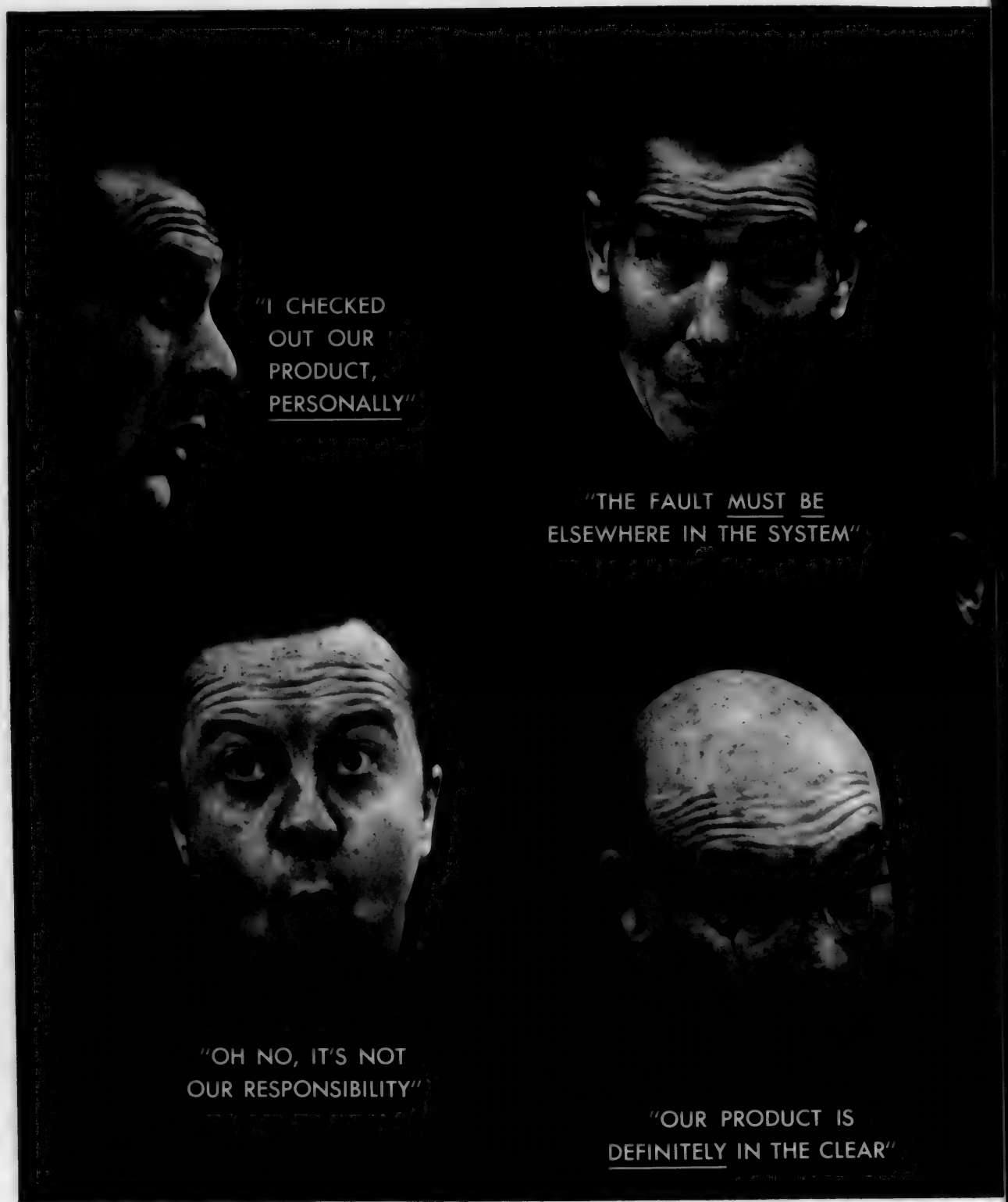
BUFFALO PUMPS

Division of Buffalo Forge Co.

480 Broadway, Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities


"I CHECKED OUT OUR PRODUCT, PERSONALLY"
"THE FAULT MUST BE ELSEWHERE IN THE SYSTEM"
"OH NO, IT'S NOT OUR RESPONSIBILITY"
"OUR PRODUCT IS DEFINITELY IN THE CLEAR"

One call for all

CENTRIFUGAL REFRIGERATING MACHINES • CENTRAL-STATION AIR CONDITIONERS
PACKAGED WATER CHILLERS • PACKAGED AIR CONDITIONERS • FANCOIL UNITS
MULTI-ZONE AIR CONDITIONERS • SPRAYED COIL DEHUMIDIFIERS • HEATING AND
COOLING COILS • CENTRIFUGAL FANS • PROPELLER FANS • POWER ROOF VENTILATORS
UTILITY SETS • UNIT HEATERS • BOILERS

Why divide responsibility for air conditioning equipment?

THERE'S A SAYING that a camel is a horse designed by a committee. Not so. A camel is a horse assembled by a committee. The horse concept is still basically a sound one.

Yet, by the same token, what happens when you split responsibility for the elements in a building or plant air-conditioning, heating, and ventilating system? The components are built by separate manufacturers who are answerable only for what they make.

How much better to select *all* the major components from American-Standard* Industrial Division. You choose from the combined American Blower, Ross Heat Exchanger, and Kewanee Boiler product lines . . . have *one-source* responsibility for quality and performance in equipment designed, engineered, and manufactured to work together.

Offices, in all principal cities, staffed with product specialists, work with you in equipment selection and on-the-job problems. Give the one near you a call. AMERICAN-STANDARD INDUSTRIAL DIVISION, DETROIT 32, MICH. IN CANADA: AMERICAN-STANDARD PRODUCTS (CANADA) LIMITED, TORONTO, ONTARIO.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

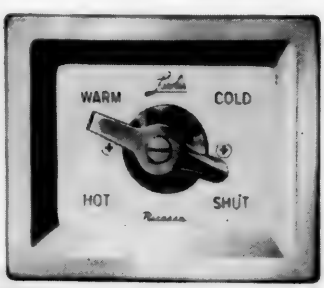
AMERICAN-Standard
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

UARY–1990

TUESDAY	EVERYDAY	THURSDAY
		1
6		8
13		15
20		22
27		29

SHOWERING COMFORT AND SAFETY FROM LAWLER SO FAR ADVANCED IT WILL NEVER GO OUT OF STYLE!



Recesso

The **Recesso's** "years ahead" styling leads the industry in thermostatic shower mixers. The **Recesso** is entirely recessed into the wall . . . eliminates dangerous protruding edges which might cause bodily injury or collect unsanitary dirt, grime and soap scum.

Lawler's advanced thermostatic element gives the **Recesso** new sensitivity and instant action for truly safe, comfortable showering. Your customers will enjoy the beauty and safety features of the **Recesso** years from now!

FOR TIMELESS PERFORMANCE STANDARDS LOOK TO LAWLER . . . FIRST!

LAWLER AUTOMATIC CONTROLS INC., MT. VERNON, N.Y.

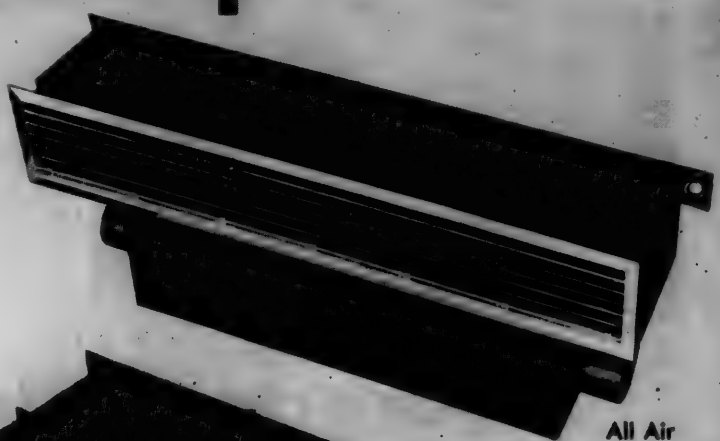
ANEMOSTAT®

is a registered trademark for a wide range of air diffusion equipment

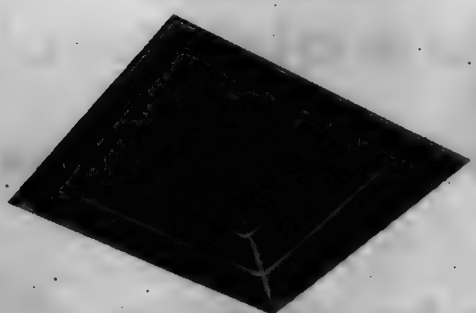
Today Anemostat offers an impressive variety of air diffusion equipment to meet every architectural and engineering requirement. ANEMOSTAT® is a registered trademark. It is your guarantee that every unit bearing this name is of highest quality . . . backed by the most experienced engineering, research and testing laboratories in the industry.

When Anemostat Air Diffusers are in sight the system is right. This was true yesterday, is true today and will be true tomorrow.

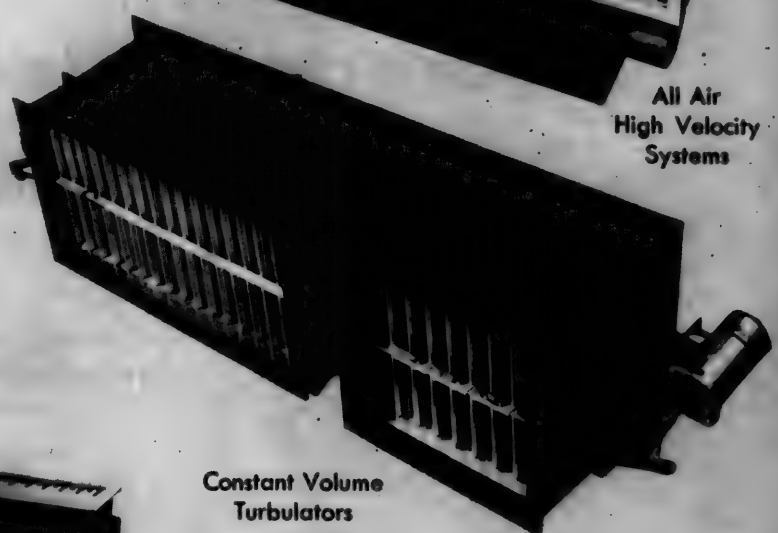
Conventional Air Diffusers



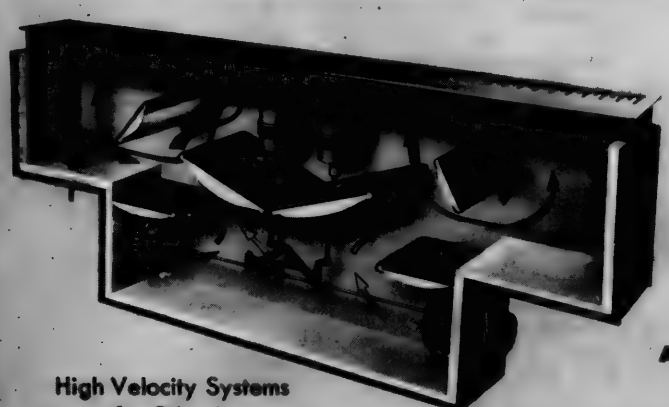
All Air High Velocity Systems



100% Induction Air Diffusers



Constant Volume Turbulators



High Velocity Systems for Schools

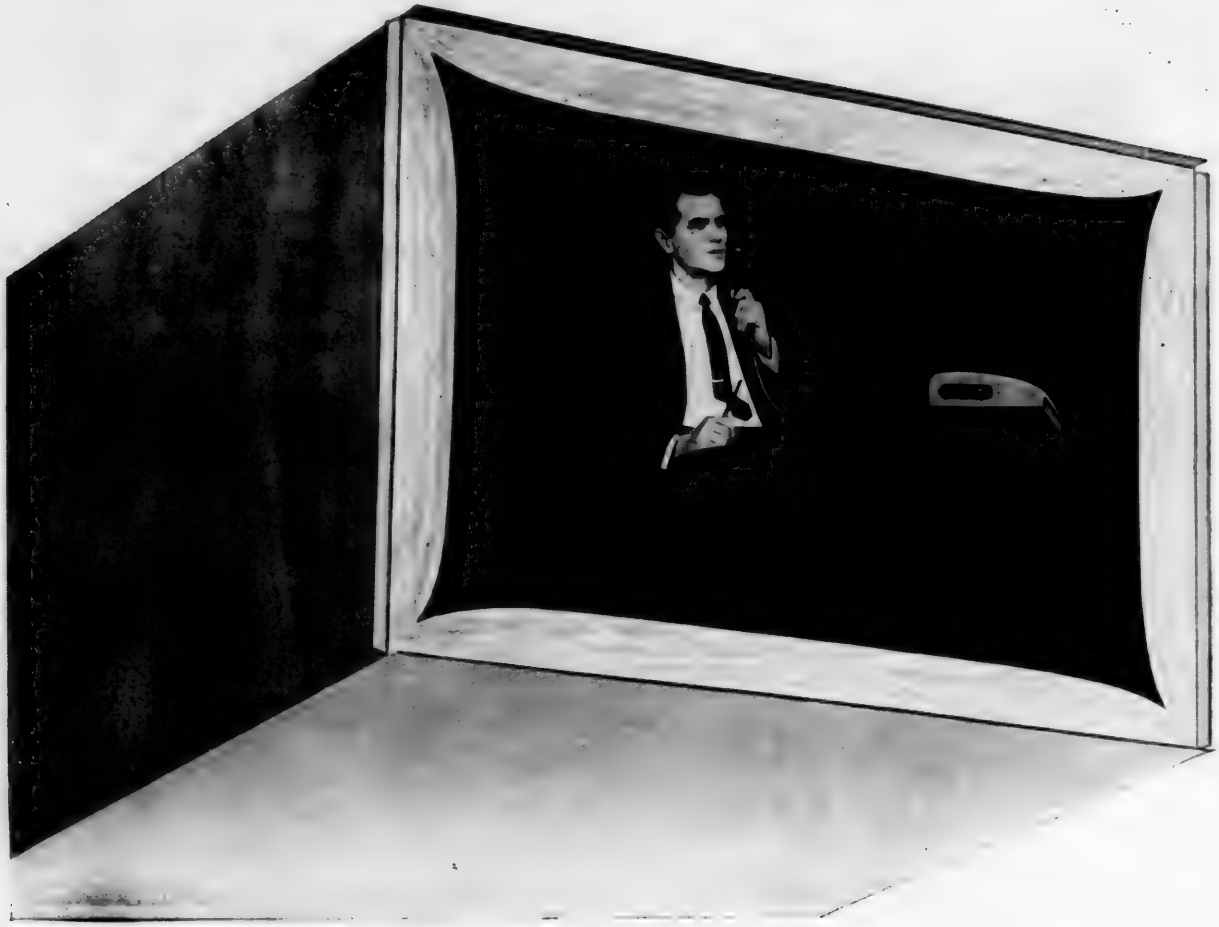
ANEMOSTAT®

ANEMOSTAT CORPORATION OF AMERICA

10 EAST 39th STREET, NEW YORK 16, N. Y.

Representatives in principal cities

"No Air Conditioning System Is Better Than Its Air Distribution"



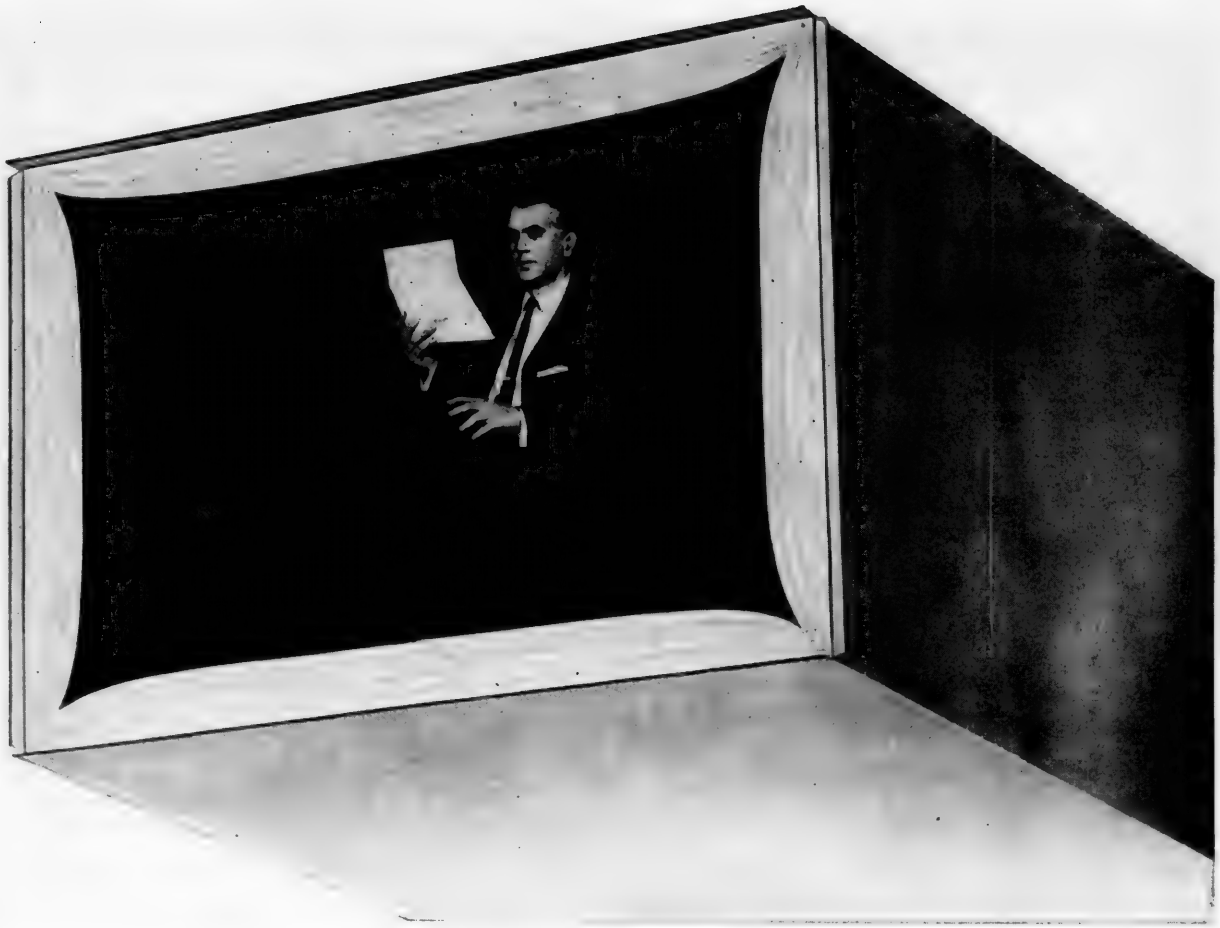
Keeps air ducts quiet . . .

J-M Microtex® fiber glass duct liner does

MICROTEX—
another quality
Johns-Manville
Fiber Glass product

WHY YOUR INSTALLED COSTS ARE LOW WITH JOHNS-MANVILLE MICROTEX . . .

- **LIGHTWEIGHT MATERIAL.** Easy to handle in the shop.
- **RESILIENT.** Can be formed with the metal in the brake.
- **STRONG.** Holds up during shop handling. Won't pull apart. Less waste.
- **EASY TO CUT AND FIT.** Regular shop methods, skills and tools speed fabrication.
- **PLEASANT TO HANDLE.** Workmen like the texture of Microtex.



keeps them efficient, too

both effectively... and at low cost

Thanks to carefully engineered metal air duct systems lined with Johns-Manville Microtex, it's quiet as a country churchyard inside many a modern building. Duct noises from motors, fans and adjacent rooms get into this fiber glass insulation—and never come out again! They're trapped and killed by countless microscopic air pockets formed by the millions of fine glass fibers.

Comfort is increased, too, because temperatures of the cooled or heated air can be more evenly controlled during distribution. This is a result of the high insulating efficiency of Microtex which also reduces power and fuel costs.

Johns-Manville Microtex is a semi-rigid blanket. The fine glass fibers are reinforced with textile yarn and bonded with a thermosetting resin. A black vinyl coating resists erosion even at top air velocities . . . eliminates need for painting inside of ducts in back of grills. Furthermore, with the insulation inside the duct, the sheet metal itself serves as the vapor barrier.

Over-all, Microtex provides maximum insulation value for dollar invested. It reduces installation costs—*see opposite page.* Its inorganic glass fibers are ageless . . . no danger of loss from rot, decay, moisture or vermin.

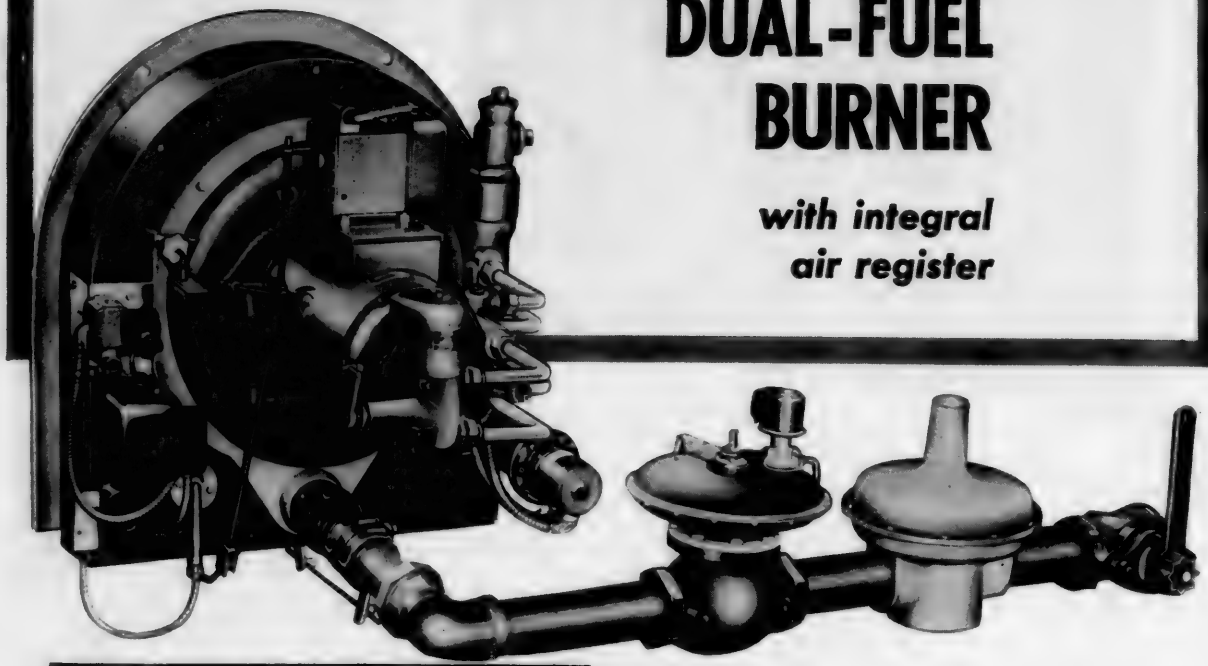
For specification and installation data on high-efficiency, low-cost Microtex, contact your nearby Johns-Manville representative. Or write to Johns-Manville, Box 14, N. Y. 16, N. Y. In Canada, Port Credit, Ont.

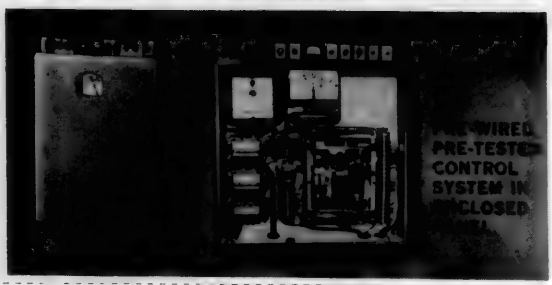
JOHNS-MANVILLE

JOHNS MANVILLE JM PRODUCTS

PETRO INDUSTRIAL DUAL-FUEL BURNER

with integral air register





For natural or induced draft firing

The secondary air register is built into the burner!

The effect of this is plain to any heating engineer—no special construction is required to supply air to the combustion chamber. No draft door, no boiler pit, no checkered floor. Also the critical refractory combustion throat (so vital to efficient combustion) is pre-formed at the factory—you take no chances on local fabrication.

The burner (for either oil or gas, or dual-fuel combination) is remarkably free from mechanical complexities. It handles the heaviest oils or any type of gas with precision and dependability. *It stays on the job.*

Complete control systems are available from the factory. They are designed, built and tested with the same degree of care that the burner receives. The factory-integrated combination of the burner package and control system package provides maximum skill and undivided responsibility for the complete firing system.

Capacities: 30 to 450 boiler hp, gas or oil.

For further information, please mail coupon.

PETRO
3328 West 106th Street, Cleveland 11, Ohio
(In Canada: 80 Ward Street, Toronto, Ontario)

Please send me literature and specification sheets on money-saving Petro Gas-Oil Burners.

Name .....

Company .....

Address .....

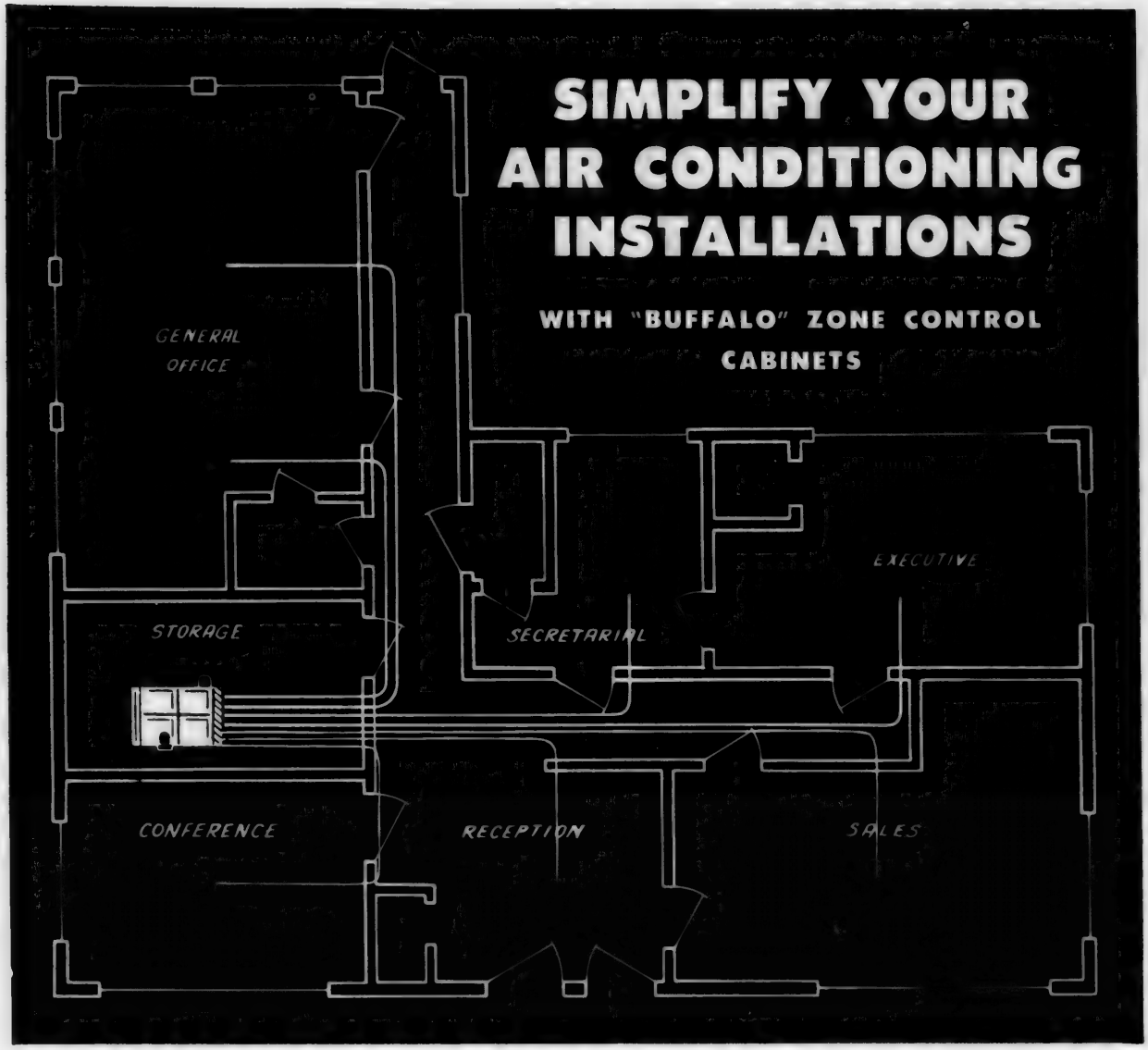
City ..... State .....

PETRO®

Makers of quality heating and power equipment since 1903

SIMPLIFY YOUR AIR CONDITIONING INSTALLATIONS

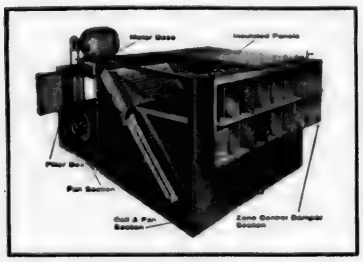
WITH "BUFFALO" ZONE CONTROL CABINETS



These quiet, compact, highly-efficient units are designed for installations where it is most feasible to use a single unit to provide varying degrees of conditioned air for several zones.

- Easy to assemble and install — shipped with sectionalized units, including fan and coil sections, zone dampers and optional accessories.
- Dependable, maintenance-free operation — heavy-gauge, corrosion-resistant construction insures long, satisfactory life on the job.
- Convenient to service — handy access doors, removable panels and outside-located bearings simplify servicing needs.
- Flexible — many combinations available — optional floor or ceiling mounting clips available; can be adapted to any combination of heating, cooling and/or dehumidifying.
- Space-saving design — unique coil angle permits maximum coil face area within minimum headroom and length.

Investigate the many advantages of "Buffalo" Zone Control Cabinets. Call your "Buffalo" engineering representative, or write for Bulletin AC-220.
"Buffalo" brings you "Q" Factor value — the built-in QUALITY that provides trouble-free satisfaction and long life.



Individual Year 'Round Comfort for all with this one compact unit! Temperature is controlled by mixing cooled and heated air in correct proportions to suit each conditioned space. No need for separate re-heat coils and their controls. Control for each area can be manual or completely automatic.

BUFFALO FORGE COMPANY
Buffalo, N. Y.
Buffalo Pumps Division, Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Now we're cooling

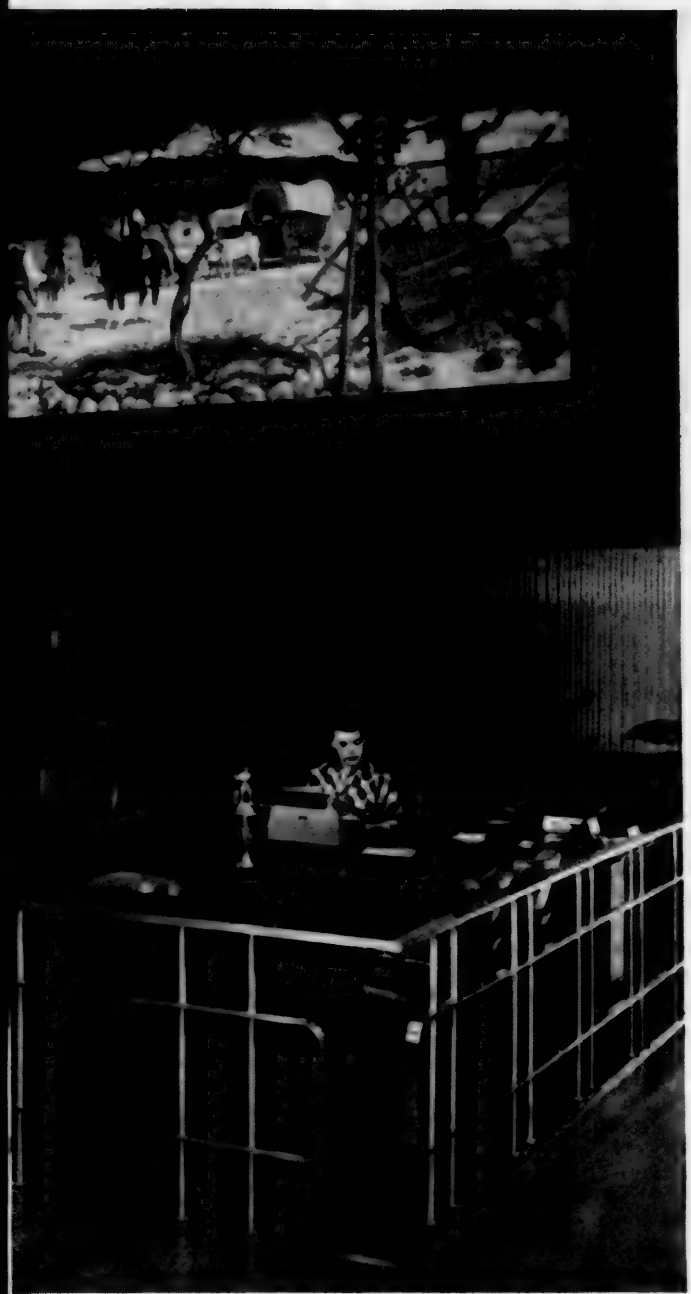
with **GAS**

. . . and saving too!

Arkla-Servel Gas Air Conditioning keeps work efficiency high and operating costs down at First Federal Savings in Alhambra, California.

"When planning our new main office in Alhambra, we made a complete survey of all types of air conditioning equipment," states First Federal. "Our answer was Arkla-Servel gas-operated water chilling units, and we're completely satisfied with the results.

"With our Arkla-Servel units, we keep our staff cool in summer with the same compact system that keeps them warm in winter," adds Mr. D. A.



Check these features of the 25-ton Arkla-Servel water chiller

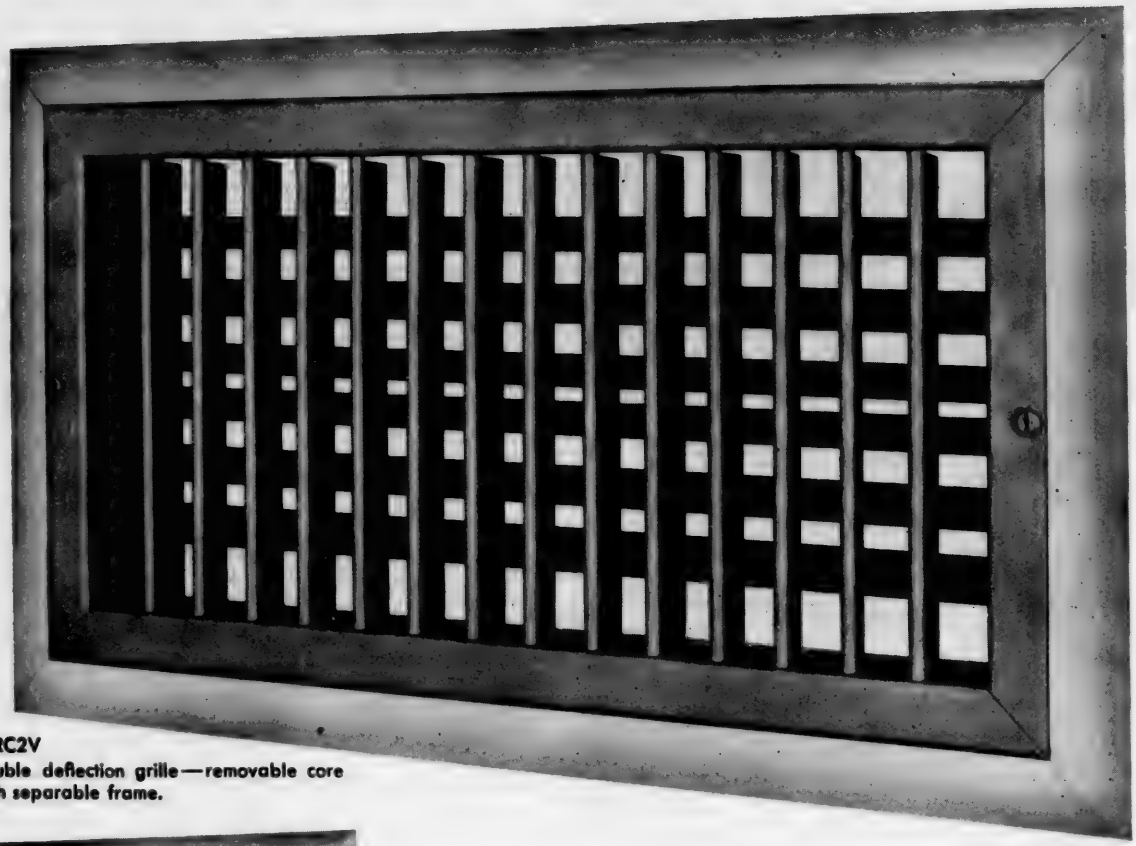
- Quiet and vibrationless . . . operates with no moving parts
- Low installation, operating and maintenance costs
- Can be installed singly or in banks to fit any need
- Compact and easy to install; light enough for rooftop installation

Thompson, Sr. V.P. "We get top working efficiency at the lowest possible operating costs. And we get further savings because our Arkla-Servel unit is installed on the roof – utilizing otherwise useless space – and requires practically no maintenance."

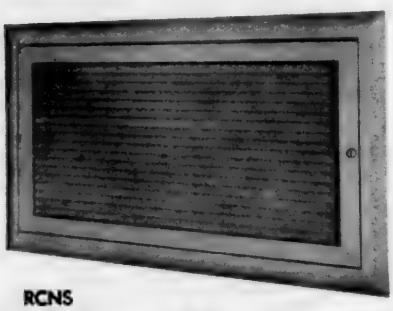
Check the facts and you too will see that modern Gas air conditioning out-performs all others. For specific details call your local Gas Company's air conditioning specialist, or write to the Arkla Air Conditioning Corporation, General Sales Office, 812 Main Street, Little Rock, Ark. *American Gas Association.*

Now... WATERLOO *presents*

removable core grilles



RC2V
Double deflection grille—removable core with separable frame.



RCNS
"No-Site" inverted V shaped blades with removable core and separable frame.

RC3HD
Return air grille with fins fixed at 45° with removable core and separable frame.

Completely removable cores—unique design separable frames

Designed to enhance all modern interiors, these new Waterloo removable core grilles offer many significant advantages:

1. Cores slip out easily—prevent damage to plaster or painted walls.

2. Unique design separable frames allow maximum free area. Trim radius edges of frames add streamline appearance to room decors.

3. Removable core grilles are either all aluminum construction or separable aluminum frames with conventional cores. Either type may be specified.

4. Waterloo removable cores are available with models shown or on any other Waterloo supply and return grilles or registers.

Reap these benefits by specifying Waterloo removable core grilles on your next job. *Write for new comprehensive Waterloo Catalog.*

WR-110

WATERLOO
Air Diffusion
EQUIPMENT

WATERLOO REGISTER COMPANY, INC.
WATERLOO, IOWA

BEFORE YOU BUY, THINK:

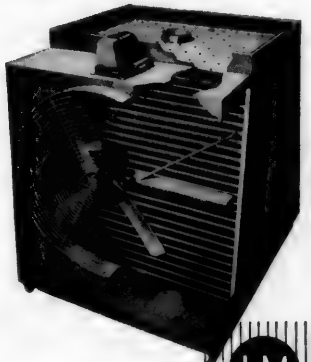
Will fungus attack your cooling tower 2 years from now?

Not if it's a Halstead & Mitchell cooling tower with a 20-Year Guarantee

The specially treated wood decking in H&M towers resists rotting, fungus attack and algae which accumulates and obstructs air flow in most other towers. Performance remains "like new" in H&M cooling towers year after year.

Only Halstead & Mitchell offers a 20-Year Guarantee on the wetted deck against failure due to rotting or fungus attack.

Other H&M features for unusually low maintenance include permanently sealed fan bearings, and a heavy gauge steel cabinet protected against corrosion by three plastic coats applied *after assembly*. Be sure. Ask your local wholesaler for H & M towers, or write to Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Pa.



H & M COOLING TOWER WITH PRESSURE TREATED DECKING

HM

Halstead & Mitchell

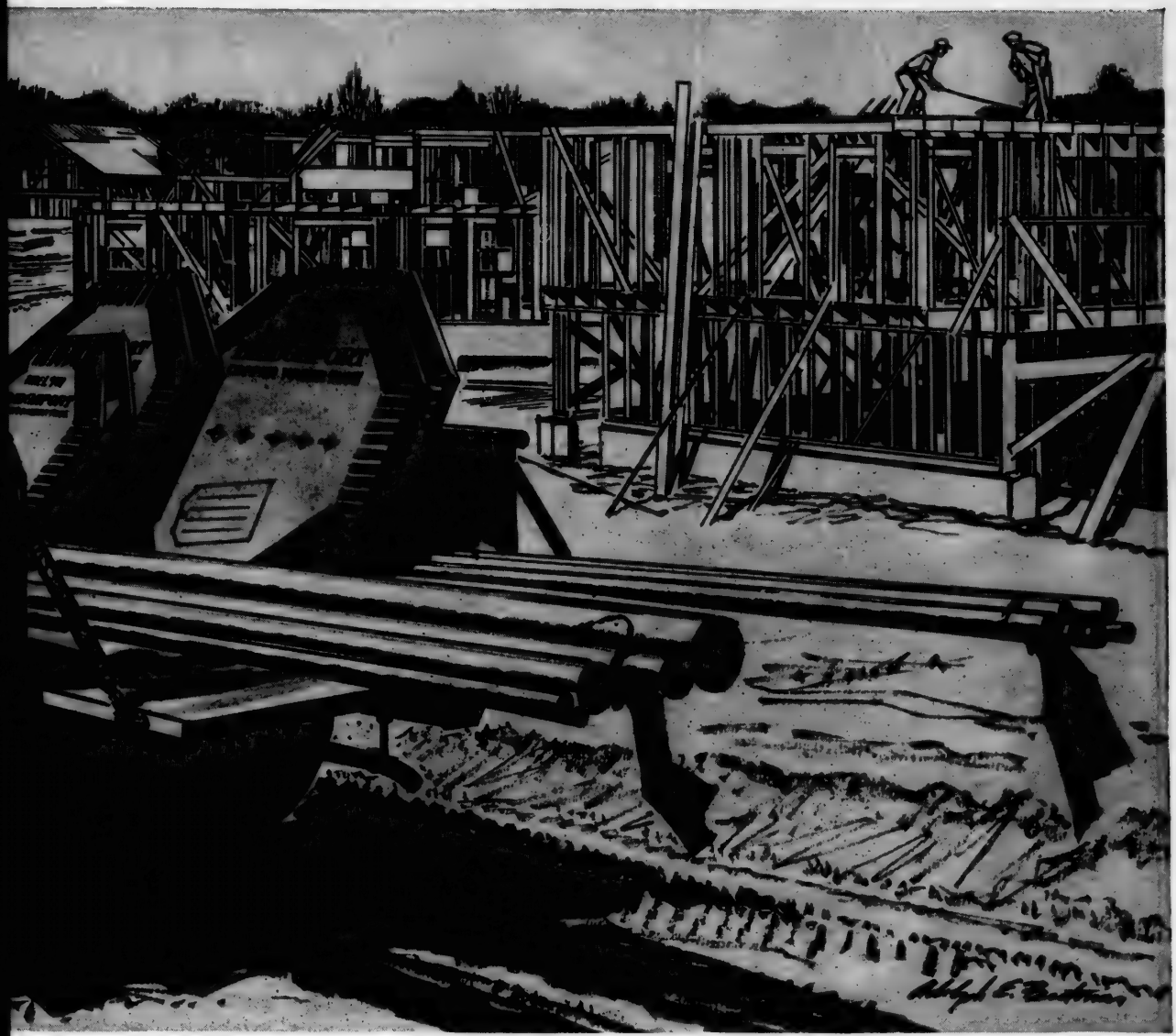
Water-Cooled Condensers · Cooling Towers · Air-Cooled Condensers · Finned Coil Products

THREE MEN ON

Here's Why Architects, Engineers and Contractors Mak

THE ARCHITECT wants the best for his buildings. Wants to know that what he specifies in copper water drainage and refrigeration tube bears a name that *means* quality. Wants to know, too, that what goes into his buildings goes in *permanently*. He knows that when he specifies "Bridgeport" as the source for copper tube, his specifications are met to the fullest degree.

THE ENGINEER's basic need is to be certain that what he recommends is *constantly dependable*. He's got to be sure that every foot of the copper tube that goes into the job will do the job. He wants to know, too, that the source of his copper tube is able to provide any technical assistance he may require. He's sure of *both* with Bridgeport.



A "SOURCE"

BRIDGEPORT Their Source for Copper Tube

Everything **THE CONTRACTOR** puts into his buildings reflects directly on him. The success of the job is based on the quality of his materials and the service he gets from his suppliers. With Bridgeport, both quality and service are superior. The big jobs require well-timed deliveries, product uniformity and easy workability to get the big jobs done faster. He looks to

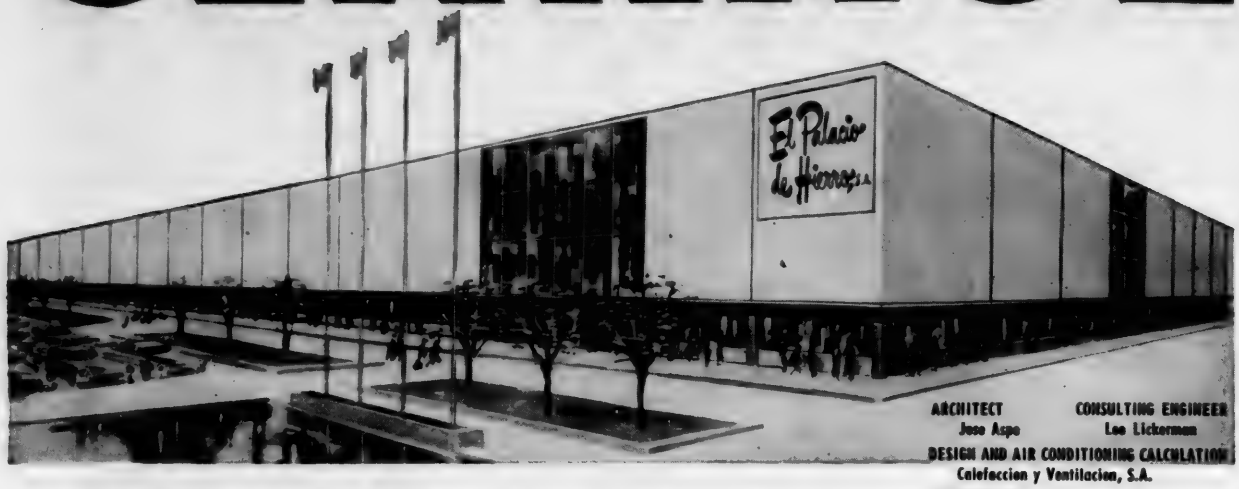
"YOUR GUIDE TO BRIDGEPORT PLUMBING, HEATING AND AIR CONDITIONING PRODUCTS"
—is the title of our four-page booklet on types, sizes, weights and strengths of all of Bridgeport's copper water and drainage tube. We'd like you to have a copy. Send your request to Dept. 5203.

BRIDGEPORT BRASS COMPANY

Bridgeport Brass Company, Bridgeport 2, Conn. • Sales Offices in Principal Cities

*Specialists in Metals from **A**luminum to **Z**irconium*

CLARAGE



ARCHITECT
Jose Aspe

CONSULTING ENGINEER
Lee Lickerman

DESIGN AND AIR CONDITIONING CALCULATION
Calefaccion y Ventilacion, S.A.

CONTRACTOR
Calefaccion y Ventilacion, S.A.

Forward striding Mexico...

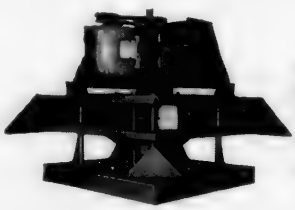
another land where Clarage gives air a lift

World-wide, Clarage quality is known and called upon. Down Mexico City way, for example, is the new Palacio de Hierro.

Here, in this city's largest and most modern department store, Clarage air handling and conditioning equipment is at work — Capillary Air Washers and Centrilator Power Roof Ventilators. Why is Clarage so often selected for buildings of all types, all sizes? Largely because of this equipment's reputation for faithful performance and operating economy.

Contact our nearest sales engineering office. You too will find it's characteristic of Clarage products to prove out successfully no matter how challenging the requirements.

REQUEST CATALOG 405 covering the Clarage Capillary Air Washer. Equipped with capillary cells. Three arrangements available. Capacities 4,400 to 132,000 CFM.



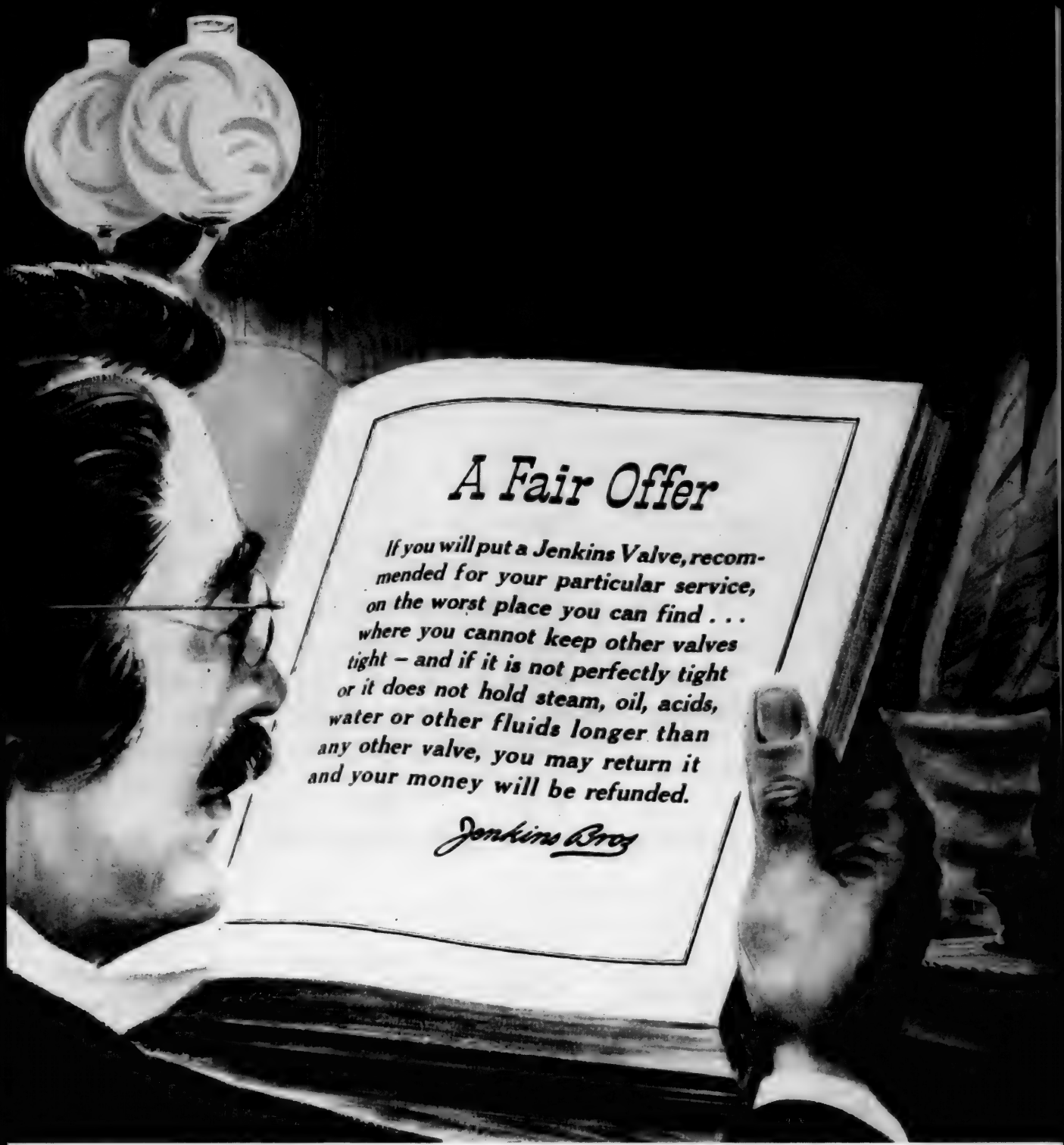
REQUEST BULLETIN 550 covering the Clarage Centrilator Power Roof Ventilator. Static pressures to 2"; capacities to 26,400 CFM. (Unit shown here without cover.)

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal


A Fair Offer
If you will put a Jenkins Valve, recommended for your particular service, on the worst place you can find . . . where you cannot keep other valves tight – and if it is not perfectly tight or it does not hold steam, oil, acids, water or other fluids longer than any other valve, you may return it and your money will be refunded.
Jenkins Bros

PUBLISHED AND PROVED FOR **90 YEARS**

This simple, straightforward statement of selling policy was first published in 1869, five years after Jenkins Bros. was founded. It has been continued in full effect through 90 years of Jenkins Bros. history of making valves to a standard of quality that warrants such an unparalleled assurance to buyers.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

JENKINS SINCE 1864 Jenkins Bros

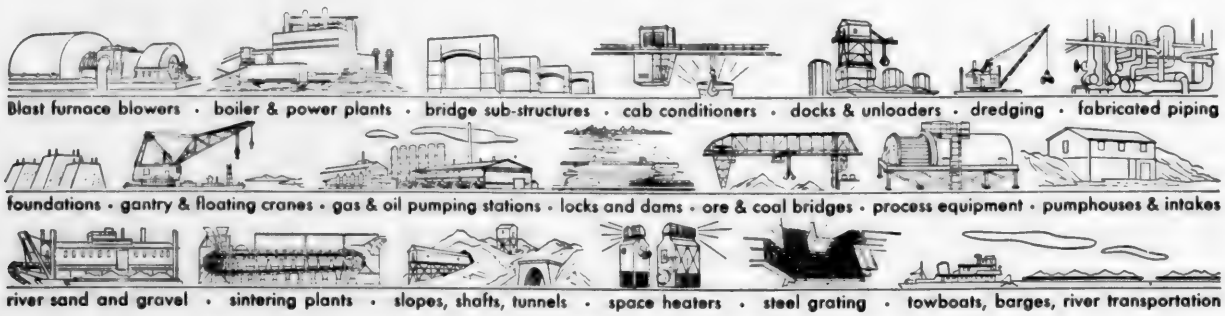
Big warehouse keeps warm with four heaters

This 79,000 square foot warehouse of the C. A. Turner Company, Rankin, Pa., has high roof areas and large access doors. Yet, only four Dravo *Counterflo* heaters were needed to maintain a 68° comfort level during last January's severe cold spell with its frequent sub-zero temperatures. Fuel costs for the month were 7/10¢ per square foot!

More than 20,000 Dravo heaters, in use throughout the world, provide this same low cost heating in manufacturing plants, schools, commercial and public buildings. A factory-trained organization handles service on 24-hour call.

Are you paying for inadequate, obsolete or inefficient heating? A Dravo engineer will evaluate your present system now at no obligation. For information on this, or any of the other services and products pictured below, write DRAVO CORPORATION, PITTSBURGH 25, PENNSYLVANIA.

DRAVO
CORPORATION



Blast furnace blowers · boiler & power plants · bridge sub-structures · cab conditioners · docks & unloaders · dredging · fabricated piping

foundations · gantry & floating cranes · gas & oil pumping stations · locks and dams · ore & coal bridges · process equipment · pumphouses & intakes

river sand and gravel · sintering plants · slopes, shafts, tunnels · space heaters · steel grating · towboats, barges, river transportation

Climate by Chrysler

500 tons of cooling power from a 400-hp motor brings double savings to new Greenville Auditorium

A 500-ton Chrysler Centrifugal Liquid Chiller is the heart of the air conditioning system in the new Memorial Auditorium in Greenville, S. C. It cost less to install . . . and every second it operates, it's saving more money. Here's why:

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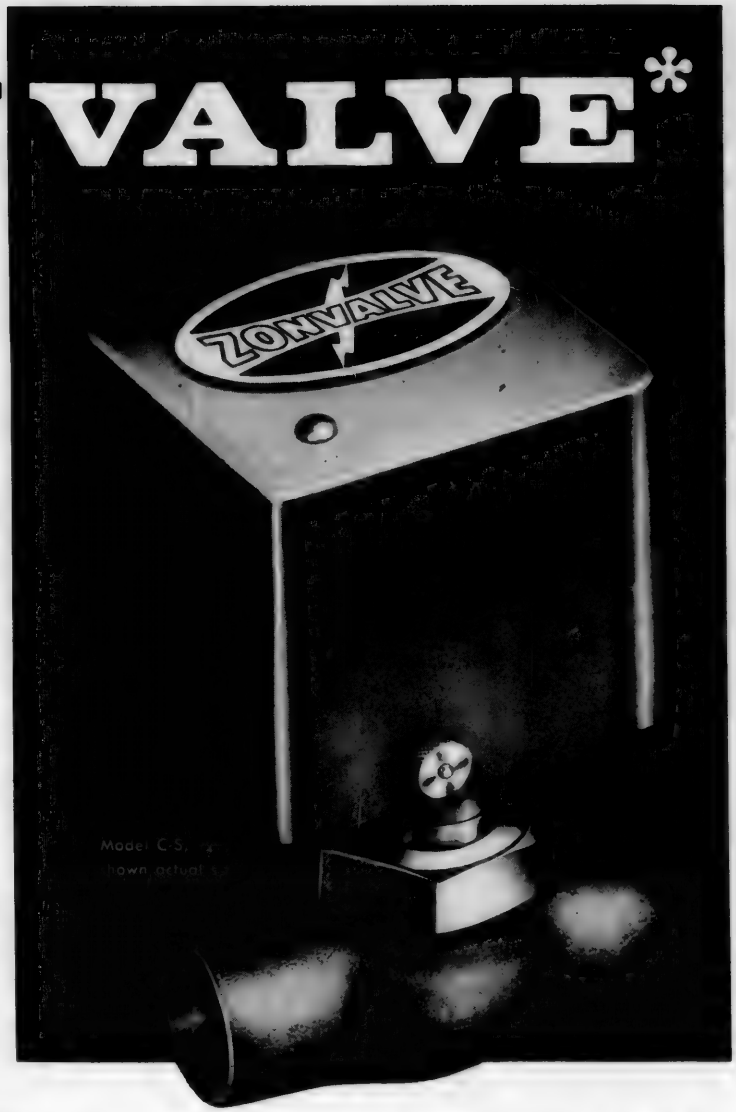

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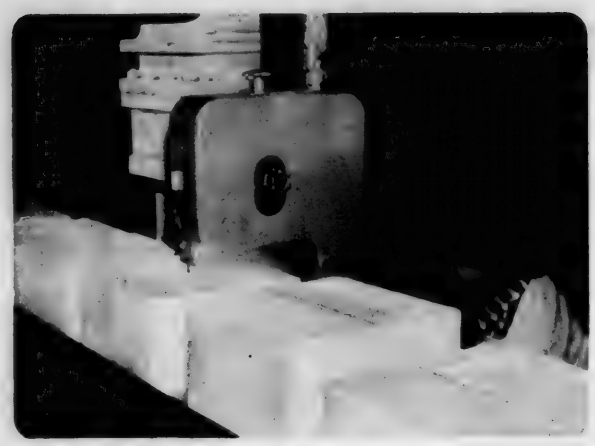

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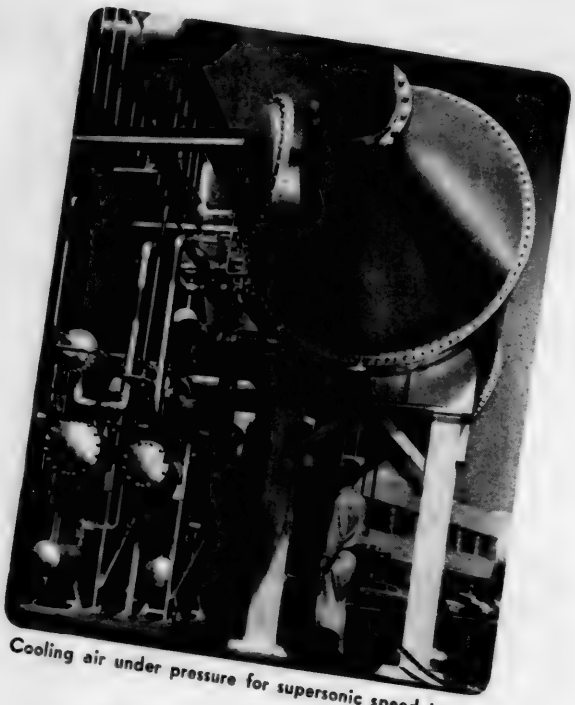

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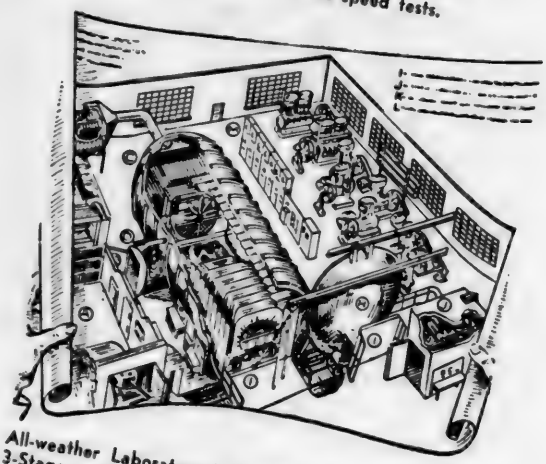

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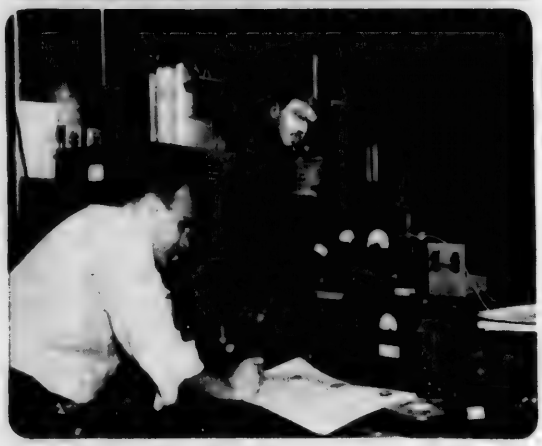

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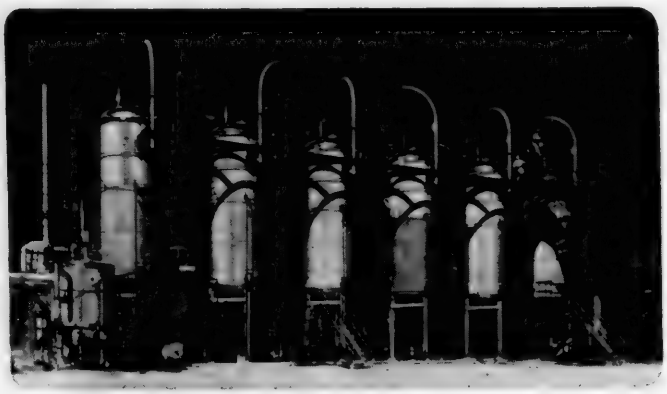

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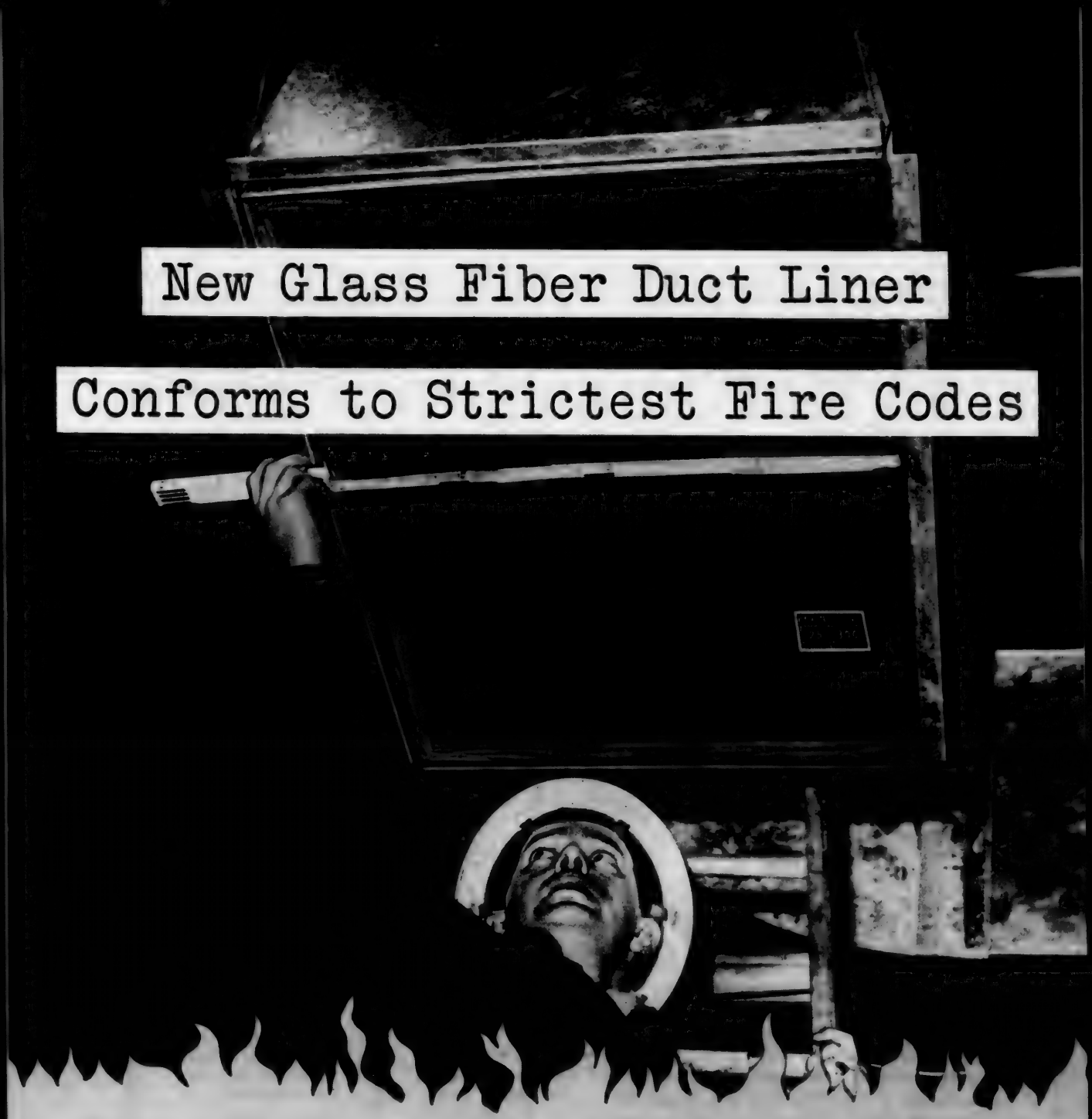

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These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

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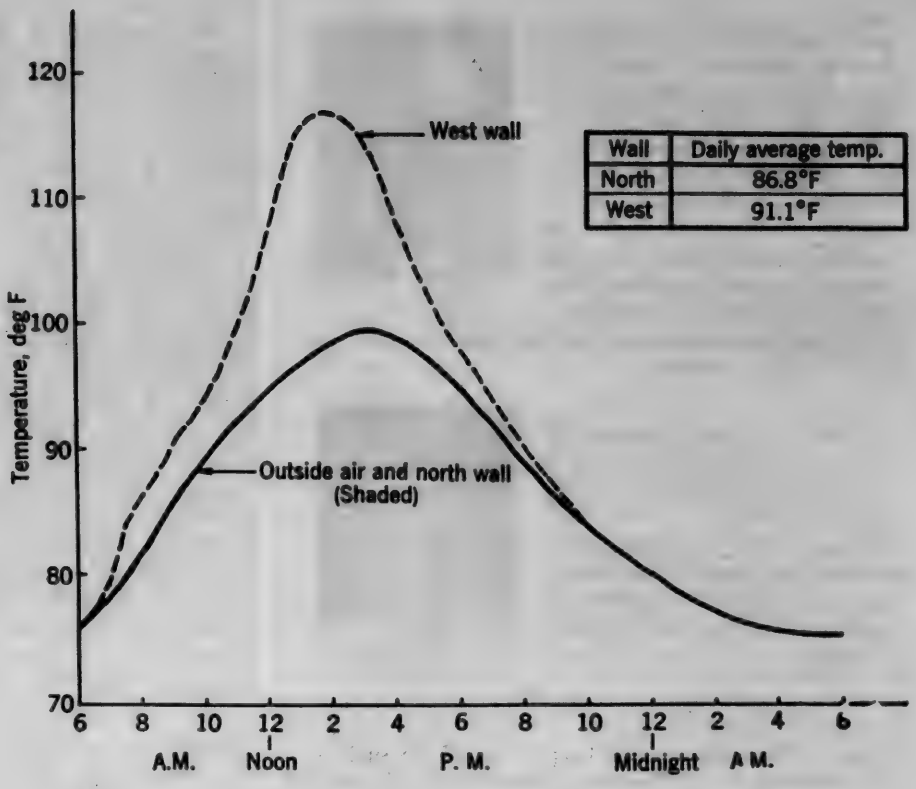
Summer wall surface temperatures plotted against time, for Austin Tex. See page 57.



Wall	Daily average temp.
North	86.8°F
West	91.1°F

Specifying Vapor Barriers For Year-Round Air Conditioning

W. R. WOOLRICH and H. T. MEI
The University of Texas, Austin

A number of law suits against specification writers, because of serious warping and buckling of insulated houses with year-round air-conditioning systems, as well as the refusal of some of the best painting contractors to guarantee their work done on such houses, has prompted research into the causes of this condition. The following is a progress report based on such research, sponsored by the National Mineral Wool Association. The project has as its goal the correction and rewriting of the instructions for engineers and architects on the installation of fibrous forms of insulation in climates where rooms are heated in winter and air cooled in summer, in each case requiring the installation of vapor barriers.

ORDINARY calculations of heat loss and gain are based upon the assumption that the temperature gradient through a wall may be represented by a straight line. The assumption is correct only when temperatures remain constant long enough for the flow of heat to have attained a steady state. This condition seldom exists, in reality, for even a short period. In hot, dry climates, after sundown, it is not uncommon for the interior temperature of an insulated wall to be higher than either surface, with flow of heat outward in both directions.

Unsteady flow in a building wall is more important during the cooling than during the heating season because the daily range of outdoor temperature is commonly greater in summer than in winter. Also, the daily range of incident solar energy upon a given building wall has a greater proportionate effect in summer than in winter.

Willis R. Woolrich, dean of engineering and director of the Bureau of Engineering Research, The University of Texas, is currently serving as consultant and interim president of Middle East Technical University, Ankara, Turkey. He has been a consultant mechanical engineer to the process industries, director of the TVA Small Industries Division, a consultant to the Patents Board, and to the Department of the Interior on desalting of saline waters, president of the Texas Academy of Science; director, American Society of Refrigeration Engineers; vice-president, American Society of Mechanical Engineers; and an author of books on air conditioning, refrigeration, steam engineering, and of over one hundred technical and scientific bulletins and papers.

H. T. Mai is a research engineer with the Bureau of Engineering Research of the University of Texas and teaching assistant in its Department of Engineering. He received his Bachelor of Science degree from National Taiwan University in Formosa, Republic of China. In 1954 he was admitted to the Graduate School of the University of Texas and in 1956 was awarded a masters degree in mechanical engineering. He is presently a candidate for a doctorate in the same field, specializing in air conditioning.

It is not uncommon for the temperature of the surface of a wall exposed to the sun to rise 40-50 deg F above ambient air. Black, horizontal surface temperatures have been recorded as high as 223 deg in daytime, and 8 deg below air wet bulb at night in Austin, Tex. Therefore, it is not logical to attempt to predict the flow of heat through walls or roofs during the summer on the assumption of steady flow.

The rate of transmission of moisture through a wall depends upon the vapor permeability of the materials of which it is constructed and the difference in vapor pressure across the wall. If, in Fig. 1, the rate of vapor transmission from the warm side of the wall to the inner surface of the cold side, *x-x*, is greater than the rate of transmission *through* the cold side, condensation will accumulate on the surface, *x-x*; whether it be frost or liquid depends upon the temperature of the surface.

In winter, surface *x-x* is usually colder than the dew-point of the air on the warm side. Often, in order to prevent condensation, a vapor barrier is installed on the warm side. But, when the house, so insulated for winter, is cooled in summer, condensation forms within the walls. This phenomenon baffles many, and prompts one to inquire how a vapor barrier can be installed for the house air conditioned year-round.

Reverse Flow

In those regions where the change in wet-bulb temperature during clear days and nights does not exceed 6 deg during the summer months, there need be no fear of condensation if the rooms are maintained at a dry-bulb temperature no lower than 75 deg. A different situation is an instance where a new, $150,000 Texas house was seriously damaged by condensation within its walls after only a half-year occupancy. The climate is normally hot and dry, and other conditions were as outlined above, except that the owner had maintained the rooms between 67 and 70 deg.

This "reverse flow" of heat and vapor is a very real problem in certain buildings in hot climates unless some precautions are taken. Not the least of these is the careful calculation of the location of the vapor barrier.

Assume that Fig. 1 represents the wall described in Example 1, page 129, ASHAE 1959 *Guide*. A condition of 70 deg and 50% rh on the inside, and 0 deg, 80% rh exists on the outside in winter. This wall consists of painted plaster on lath, nailed over 2x4 studs, mineral wool fill, wood exterior sheathing, paper, and pine lap siding. Permeances, conductances, densities, and other physical data are specified. A plugging in of these data into the vapor flow formula indicated a rate of vapor transmission from the warm side of 0.30 grains per sq ft per hr, and a rate of 0.06 grains transmitted through the cold side. Thus a vapor barrier is recommended to be installed at section *2-2* for winter protection.

Suppose this wall is part of an Austin, Tex., house. In summer it is exposed to an outside design condition of 100 deg and 40% rh, with indoor conditions remaining the same as in winter. A steady-state heat flow calculation indicated that the temperature of surface *2-2* is 71.84 deg, and that the temperature of the vapor barrier surface is above the outside dew point of 71.2 deg. It *looks* like there is no danger of condensation.

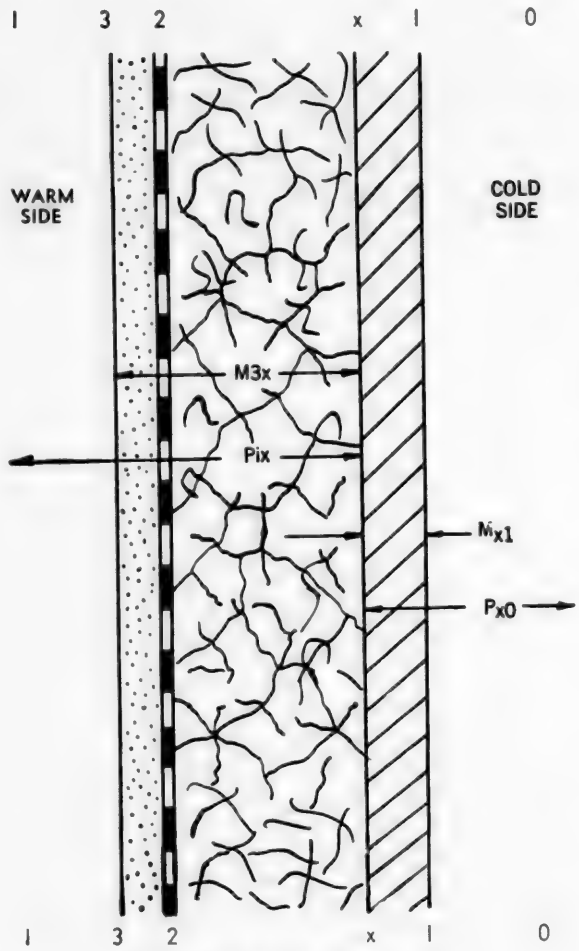


Fig. 1. Wall with vapor barrier.

Condensation in North Wall

Actually, there is a considerable danger of condensation. The double graph on page 55 shows the temperature variation over a period of 24 hours of the outer north and west wall surfaces of an air-conditioned building in Austin. By the method of Mackey and Wright (ASHVE *Transactions*, Vol. 52) it can be shown that the temperatures of the vapor barriers in the north and west walls go as low as 71.03 and 71.27 deg, respectively. Thus, it is seen that the north wall is likely to experience condensation within it. If humidity conditions worsen, condensation will most certainly become a serious problem.

At 100 deg and 40%rh, the dew point is 71.2 deg. At the same dry-bulb, but at 45 and 50%rh, the dew points rise to 74.8 and 78 deg, respectively. The time lag in cooling and heating of such a wall is about 6 hours. From the graph, minimum wall temperature is 76 deg, which temperature will occur 4 hours after midnight. The vapor barrier surface temperature will then reach a dew point temperature about 10 hours (4+6) after midnight, indicating an accumulation of condensation from about 9:30 to 10:30 a.m.

Condensation Ruins Ceiling

A multi-story building examined recently has a concrete slab roof, hot mopped on the top with black asphalt as an added moisture barrier. This building was insulated beneath with 2 inches of fibrous material and then given a room ceiling of a dense plaster, ¾ inches thick. The top floor was used for culinary cooking. After a few weeks of building occupancy, the top floor tenant reported that the plaster had cracked in two places and he observed that after each clear night there was a dripping out of each crack between sunrise and 10:00 a.m. of about a half pint. Obviously, moisture daily penetrated the plaster. On clear nights, sky cooling brought on condensation within the insulation. Initially, this must have brought on sufficient pressure after sunrise to cause the plaster to crack. Subsequently, these morning releases of condensate, when the static head of water overbalanced the vapor pressure, spilled into the room below.

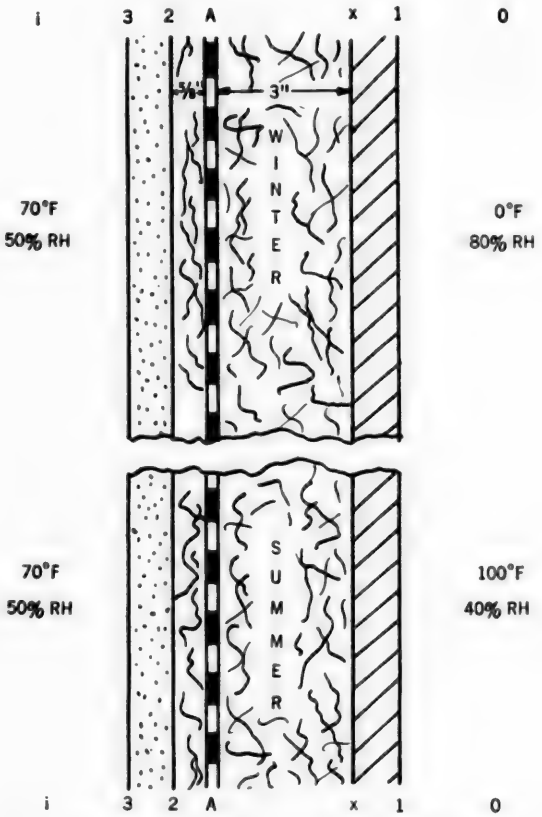


Fig. 2. Wall with barrier moved inward.

Move the Vapor Barrier!

Three possible methods suggest themselves, by which condensation in a wall or roof may be prevented:

(1) *Reduce the relative humidity of the warm side.* This method is impractical since, during the summer, the outdoors are uncontrollable, and during cold weather, the relative humidity is desirable for both health and comfort.

(2) *Ventilate the wall.* It is possible, in theory at least, to balance the movement of moisture through walls by means of ventilation. This could be done by actually venting the cold side to the outdoor air. But, when the relative humidity of outside air is high, it may take only a few degrees drop in temperature to bring the air to a saturated condition. If the inner cold-side surface temperature is lower than the outside air dew-point temperature, vapor will condense on it when the air reaches the surface. Thus, condensation is not cured by ventilation unless the outdoor air is quite dry. But ventilation has been of great value in minimizing moisture problems in attic spaces and on the underside of flat roofs. Also, ventilation of *some* side walls appears to be about the only method that would allow moisture to escape.

(3) *Install a vapor barrier.* This is the method generally recommended to eliminate condensation in walls to prevent the movement of water vapor from the warm side of walls. Since a difference in vapor pressure across a wall can cause moisture to move into a wall faster than it moves out, water vapor can best be kept out by installation of a vapor barrier on the warm side of the insulation. Location of the barrier is critical. It must be so placed that its temperature will always be above the dew point of the warm side condition.

If the vapor barrier of Fig. 1 is moved from *2-2* to *A-A*, as in Fig. 2, which is ⅝ inches from *2-2*, or 3 inches from *x-x*, the barrier temperature will be 56 deg in winter, and 73.6 deg during the cooling season. These temperatures are above the dew-point temperatures (51 and 71.2 deg, respectively) of the warm side condition during the heating and cooling seasons, so that no condensation will accumulate in the walls.

A Design Riddle

The modern home, cooled below the atmospheric dew point in summer, and heated in winter against outside freezing temperatures, poses a design riddle. If vapor

barriers are used on both sides of its insulation, the vapor in the ambient air may enter through smaller pinhole openings, forming droplets of condensation within the space. To avoid this, the intermediate insulated space should be amply ventilated. Extreme cases have been observed where the water, accumulated and trapped in the bottom of such moisture barrier spaces, could be measured in pints. One method that has been proposed involves the arrangement of each barrier with controlled ports so that the side which is warm can be made vapor tight, while the cold side is allowed to breathe.

A word of caution: The authors have observed, and their observations are corroborated by a number of competent engineers and contractors, that most plastic and metallic foil vapor barriers are short lived, some even giving way within two or three years. Seldom do they find such a barrier that is effective after the 14th year subsequent to installation.

This is so serious in some areas that the more reliable insulation contractors refuse to guarantee their work against condensation penetration unless they are permitted to install metallic vapor seals designed to resist mutilation and tearing by other craftsmen employed on the building under construction. There is a great need for a vapor seal that will approach the useful life of the building to be insulated. As of this writing, this problem remains only partially solved.

In Conclusion

In conclusion, the authors want to emphasize that the location of the barrier is extremely important in air-conditioned buildings. To install a vapor barrier on the warm side of the wall requires a thorough investigation before application. At any rate, the vapor barrier will be most effective when it is installed so that the temperature of the barrier is above the dew point of the warm side condition. When this is not possible, a metal barrier may be the most acceptable alternative. If the occupants of an air-cooled house insist on very low temperature conditions in their rooms in the hot and humid summer periods, the only positive solution, under the present conditions of the insulating art, may be sheet metal vapor barriers on both the inside and outside surfaces, with provision for drainage and light ventilation of the insulation filling of the sandwich.

Where Will A Hurricane Strike Next?

Hurricanes affecting the United States are windstorms from the tropics in which the air revolves counterclockwise about a central calm area, the "eye." The strength of the winds must attain at least 74 mph in order for a tropical weather disturbance to qualify for the title of "hurricane." Maximum wind speeds of 100-150 mph are quite common in hurricanes striking a coast, and as much as 200 mph has occurred, the American Meteorological Society states.

The area affected by winds in excess of 74 mph may be as small as 30 miles in diameter, while in large storms this diameter may be as large as 100 miles. Outside of the high-wind core, most hurricanes approaching the United States have a large peripheral area in which the winds are less intense and diminish gradually with increasing distance from the center. The diameter of this peripheral circulation may be as large as 500 miles, but it is only the central area with winds above 74 mph for which hurricane warnings are issued. Most hurricane damage arises from inundations of coastal lands by the sea. Inland, heavy rains may produce river floods, especially in mountainous regions. Rains in the peripheral zone seldom are damaging; more often they prove beneficial as relievers of drought.

Hurricanes are water-born storms. The ones affecting the eastern half of the United States originate in the Gulf of Mexico, the Caribbean Sea and the tropical Atlantic Ocean. There are always precursors of hurricane formation. They start from weak weather disturbances; usually, though not always, a couple of days are needed for a hurricane to emerge from such a disturbance. When observations are available, these incipient centers can be clearly recognized and followed on weather charts. When intensification is suspected, military reconnaissance aircraft are dispatched to the crucial area to ascertain the state of development. When a hurricane or near-hurricane is found, it is present practice for reconnaissance aircraft to continue patrolling the storm until it strikes land or moves off into the central Atlantic Ocean. When the hurricane is close to the coast, it can be tracked with considerable accuracy with large shore-based radar sets.

From the foregoing statements, it will be seen that a surprise hurricane formation in the areas covered by detailed weather analysis and within reach of reconnaissance aircraft is very unlikely. At times storms form so close to the coast on the Gulf of Mexico and around Florida that they become a menace to the coast within a short time after their inception. In order to keep the public informed of such possibilities, the United States Weather Bureau issues advisories on storms with strongest winds of as low as 40-50 mph in addition to warnings of hurricanes. The main problem in issuing warnings is that of predicting the course of fully established hurricanes.

It is desirable that the public should be warned at least one day in advance so that adequate protective measures may be taken. In assessing the course of a hurricane, as in all endeavors at prediction, there will be some residual uncertainty which cannot be eliminated by presently known methods. For hurricanes, this concerns the place where a storm will strike and the time when it will arrive there. According to present thinking, an excellent result will have been obtained if inaccuracies in hurricane center prediction do not exceed 50 miles.

The average hurricane moves at a rate of 12-15 mph in the tropics, but the rate of motion often increases to twice this amount, at times even reaches 50-60 mph, when storms come out of the tropics and impinge on the northeastern United States. Even at a speed of 15 mph, the error in placing a center 36 hours ahead will exceed 50 miles, if the predicted course of the storm is off by as little as 10° on the 360° compass.

Various researches to develop prediction techniques for hurricanes from large-area studies have been underway for numerous years and are still being pursued. At present, the degree in refinement of calculations has well outrun the accuracy and density of the observations.

A Four-point Guide for Selecting

Cooling Tower Pumps and Piping

HOWARD HUTCHINSON
Application Engineer, Allis-Chalmers Manufacturing Co.,
Milwaukee, Wis.

Through the use of simple computations, tables and charts, step by step procedure is given for determining pipe size, head in feet of water, and the suction and discharge pipe sizes for the cooling tower pump, and the motor horsepower required for operating the pump.

SELECTING the proper pump for cooling tower applications need not be a difficult task if four points are taken into consideration. By following these points, it becomes possible for the contractor to choose pumps of minimum installation and operating cost, with the assurance of proper circulation throughout the system.

The steps to be followed are:

1. Determine the amount of water required.
2. Size the piping.
3. Determine the head in feet of water.
4. Select the pump.

The average air conditioning or refrigerating condenser requires a flow of 3 to 5 gallons per minute per ton of refrigeration. The actual rate of flow should be obtained from the condenser manufacturer's data.

Design Problem

As an example, assume a cooling load of 15 tons and a manufacturer's specified flow rate of 3 gpm per ton, then, 15 tons $\times$ 3 gpm per ton $=$ 45 gpm.

TABLE I—FRICTION OF WATER IN PIPES

Gal. per Min.	Pipe Diameter, Inches																	
	3/8		1/2		3/4		1		1 1/4		1 1/2		2		2 1/2		3	
	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft	Vel., Fps	Fric., Ft
1	1.68	4.30	1.06	1.86	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	3.36	15.0	2.11	4.78	1.20	1.21	—	—	—	—	—	—	—	—	—	—	—	—
3	5.04	31.8	3.17	10.0	1.81	2.50	1.11	.77	—	—	—	—	—	—	—	—	—	—
4	6.72	54.9	4.22	17.1	2.41	4.21	1.48	1.30	.86	.34	.63	.16	—	—	—	—	—	—
5	8.4	83.5	5.28	25.8	3.01	6.32	1.86	1.93	1.07	.51	.79	.24	—	—	—	—	—	—
10	16.8	316	10.56	95.9	6.02	23.0	3.71	6.86	2.15	1.77	1.58	.83	.96	.25	.67	.11	.43	.03
15	—	—	15.8	209	9.03	49.7	5.57	14.7	3.21	3.73	2.36	1.73	1.43	.51	.97	.17	.65	.08
20	—	—	—	—	12.0	86.1	7.42	25.1	4.29	6.34	3.15	2.94	1.91	.87	1.34	.36	.87	.13
25	—	—	—	—	15.5	132	9.28	38.4	5.36	9.62	3.94	3.82	2.39	1.29	1.67	.54	1.09	.19
30	—	—	—	—	18.1	187	11.1	54.6	6.44	13.6	4.73	6.26	2.87	1.82	2.01	.75	1.30	.26
35	—	—	—	—	—	—	13.0	73.2	7.50	18.2	5.51	8.36	3.35	2.42	2.35	1.00	1.52	.35
40	—	—	—	—	—	—	14.8	95.0	8.58	23.5	6.30	10.79	3.82	3.10	2.68	1.28	1.74	.44
45	—	—	—	—	—	—	16.7	109	9.65	29.4	7.09	13.40	4.30	3.85	3.02	1.60	1.95	.55
50	—	—	—	—	—	—	18.6	146	10.7	36.0	7.88	16.4	4.78	4.67	3.35	1.94	2.17	.66
60	—	—	—	—	—	—	22.3	209	12.9	51.0	9.46	23.2	5.74	6.59	4.02	2.72	2.60	.92
70	—	—	—	—	—	—	26.0	283	15.0	68.8	11.03	31.3	6.69	8.86	4.69	3.63	3.04	1.22
80	—	—	—	—	—	—	29.7	367	17.2	89.2	12.6	40.5	7.65	11.4	5.36	4.66	3.47	1.57
90	—	—	—	—	—	—	33.4	462	19.3	112	14.2	51.0	8.60	14.2	6.03	5.82	3.91	1.96
100	—	—	—	—	—	—	37.1	567	21.5	138	15.8	62.2	9.56	17.4	6.70	7.11	4.34	2.39
120	—	—	—	—	—	—	—	—	25.7	197	18.9	88.3	11.5	24.7	8.04	10.0	5.21	3.37
140	—	—	—	—	—	—	—	—	30.0	267	22.1	119	13.4	33.2	9.38	13.5	6.08	4.51
160	—	—	—	—	—	—	—	—	—	—	25.2	156	15.3	43.0	10.7	17.4	6.94	5.81
180	—	—	—	—	—	—	—	—	—	—	28.4	196	17.2	54.1	12.1	21.9	7.81	7.28
200	—	—	—	—	—	—	—	—	—	—	31.5	241	19.1	66.3	13.4	26.7	8.68	8.90
220	—	—	—	—	—	—	—	—	—	—	—	—	21.0	80.0	14.7	32.2	9.55	10.7
240	—	—	—	—	—	—	—	—	—	—	—	—	22.9	95.0	16.1	38.1	10.4	12.6
260	—	—	—	—	—	—	—	—	—	—	—	—	24.9	111	17.4	44.5	11.3	14.7
280	—	—	—	—	—	—	—	—	—	—	—	—	26.8	128	18.8	51.3	12.2	16.9
300	—	—	—	—	—	—	—	—	—	—	—	—	28.7	146	20.1	58.5	13.0	19.2
320	—	—	—	—	—	—	—	—	—	—	—	—	30.6	166	21.5	66.7	13.9	22.0
340	—	—	—	—	—	—	—	—	—	—	—	—	32.5	187	22.8	75.0	14.8	24.8
360	—	—	—	—	—	—	—	—	—	—	—	—	34.4	209	24.8	88.7	15.6	27.7
380	—	—	—	—	—	—	—	—	—	—	—	—	36.3	233	26.2	98.2	16.5	30.7
400	—	—	—	—	—	—	—	—	—	—	—	—	38.2	258	26.8	103	17.4	33.9

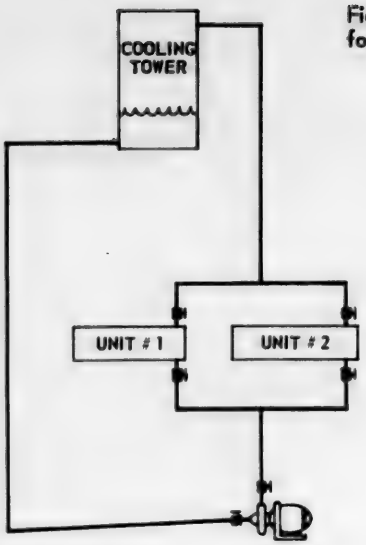


Fig. 1. Parallel piping for use with more than one unit.

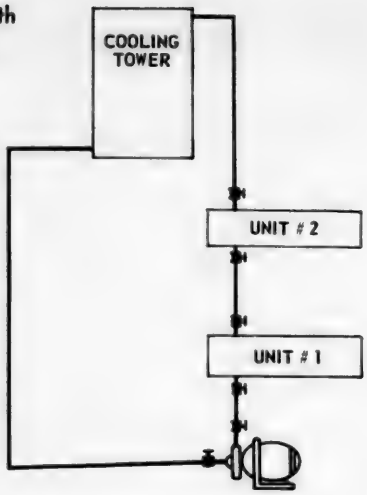


Fig. 3. System with units in series.

The piping should be sized so as to obtain a water velocity of 5 to 7 ft per second. Higher velocities create a greater friction head loss and this results in a larger and more expensive pump. Lower velocities usually would not reduce the pump cost enough to compensate for the higher cost of using larger pipe and fittings.

To determine the actual pipe size, use Table 1 which gives the friction of water in pipes. For example, at a flow rate of 45 gpm (velocity should be 5-7 feet per second), the proper pipe size would be 1½ inches. The table shows that the velocity for this problem will be 7.09 ft per second.

Recommendations for Economy

The first step in determining the head is to make a complete system layout to scale. For the best results and the most economical system, the following recommendations should be closely followed when designing this layout:

1. All units with a pressure drop must be installed on the discharge side of the pump. This includes air conditioning units or condensers, cooling towers and control valves, if used.

2. Parallel piping should be used where more than one air conditioning unit or condenser is employed as Fig. 1.

3. Water level in the supply tank should always be higher than the suction nozzle of the pump (but not more than 400 ft) to maintain flooded suction conditions, insuring a prime at all times. Pumps are often mounted on or adjacent to the cooling tower. This is quite acceptable as long as the motor is adequately protected from the weather.

4. Total length of suction piping (sum of sections *X*, *Y* and *Z*), Fig. 2, should not exceed five times the suction head.

5. Pipe section *Z* should be a long, straight run, angled slightly upward toward the pump as noted in Fig. 2.

Calculating TDH

After the layout is made, the total dynamic head (TDH) is easily calculated by adding pipe friction loss, known pressure drop and static head.

Pipe friction loss is determined by measuring in linear feet the actual length of all piping in the system plus the equivalent length for all fittings.

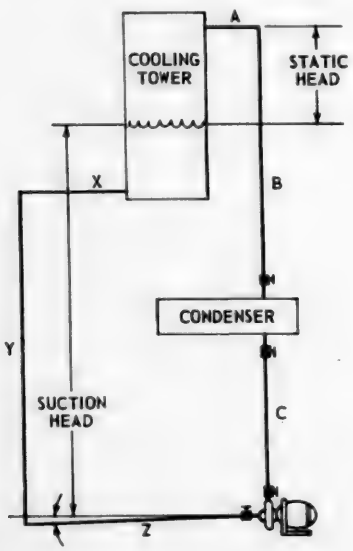


Fig. 2. Layout for design problem.

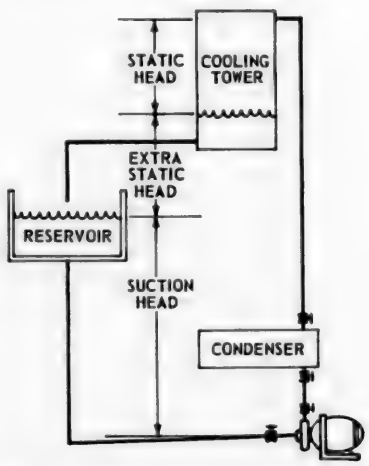


Fig. 4. Layout with both reservoir and cooling tower.

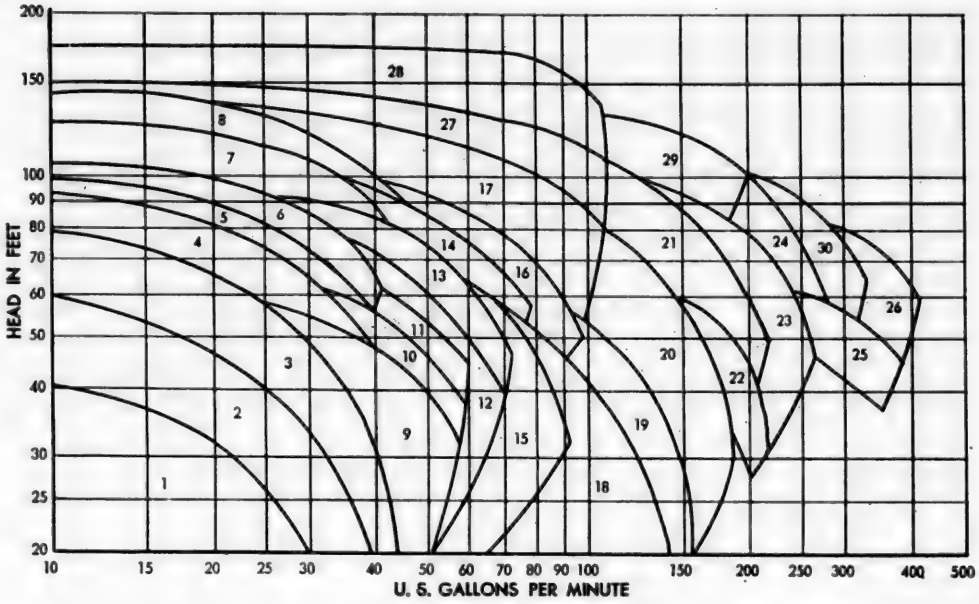
As an example, assume four regular 90° ells of the screwed type and four gate valves are used in the system shown in Fig. 2. From Fig. 7 it can be seen that the equivalent lengths for these fittings are:

Reg. 90° ell = 7.4 ft × 4 units = 29.6 ft
Gate valve = 1.2 ft × 4 units = 4.8 ft

34.4 ft

for 1½-pipe is indicated in Table 1 as 13.40 ft per 100 ft of pipe. Therefore: 1.15 × 13.40 = 15 ft head.

The known pressure drop should be obtained from the manufacturers of condensers, cooling towers and control valves, if used. In systems using more than one condenser, consider only that which has the highest pressure drop if they are installed in parallel, Fig. 1. If the condensers are installed in series, Fig. 3, the pressure drop across both must be taken into consideration.



Key	Pump Size, Inches	Hp	Key	Pump Size, Inches	Hp	Key	Pump Size, Inches	Hp
1	1 x ¾	¼	11	1 x 1	1	21	2 x 2	5
2	1 x ¾	⅓	12	1¼ x 1	1	22	2½ x 2½	3
3	1 x ¾	½	13	1¼ x 1	1½	23	2½ x 2½	5
4	1 x ¾	¾	14	1¼ x 1	2	24	2½ x 2½	7½
5	1 x ¾	1	15	1½ x 1½	1½	25	3 x 3	5
6	1¼ x 1	1	16	1½ x 1½	2	26	3 x 3	7½
7	1¼ x 1	1½	17	1½ x 1½	3	27	1½ x 1½	5
8	1¼ x 1	2	18	2 x 2	1½	28	1½ x 1½	7½
9	1 x 1	½	19	2 x 2	2	29	2 x 2	7½
10	1 x 1	¾	20	2 x 2	3	30	2½ x 2½	7½

Fig. 5. Key chart for use in selecting proper size for 3500 rpm pump.

Assume the following pipe lengths for the sections shown in Fig. 2:

Sect. A = 3.0 ft
Sect. B = 15.0 ft
Sect. C = 10.0 ft
Sect. X = 6.0 ft
Sect. Y = 18.0 ft
Sect. Z = 14.0 ft

66.0 ft

34.4 ft + 66.0 ft = 100.4 ft total length

Since the friction of water in pipe tables as Table 1 does not take into consideration variations in pipe diameter or other abnormal interior surface conditions, it is generally considered reasonable to add a 15% safety factor to this figure.

100.4 × 1.15 = 115 ft

With the flow rate of 45 gpm, the friction head loss

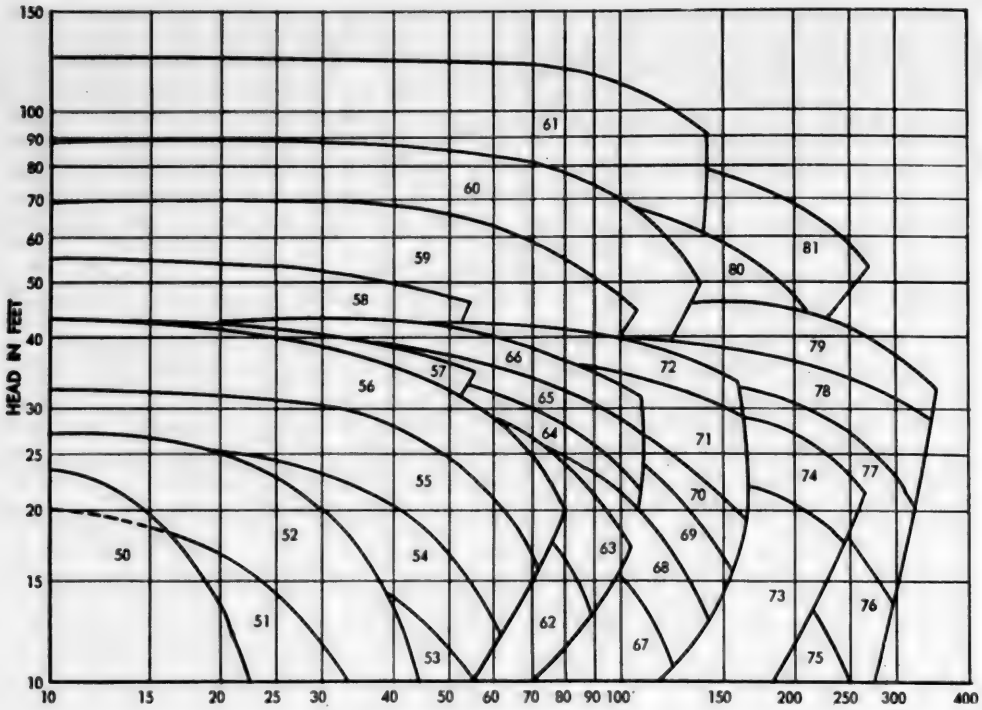
For example, assume the following pressure drops have been obtained from the manufacturer's data:

Condenser	10 psi
Cooling Tower	5 psi
Total	15 psi

To convert psi into ft of water, multiply by 2.31. Therefore:

15 psi × 2.31 = 35 ft head

Static head is the actual vertical distance which the water must be lifted. If this figure is not supplied by the cooling tower manufacturer, it can be determined from the layout. When an additional reservoir is used, the extra static head must also be considered. This arrangement, Fig. 4, is usually found in refrigerating systems; the reservoir is placed inside to prevent freezing during winter months.



Key	Pump Size, Inches	Hp	Key	Pump Size, Inches	Hp	Key	Pump Size, Inches	Hp
50	1 x 3/4	1/4	61	2 x 1 1/2	5	72	2 1/2 x 2 1/2	2
51	1 x 1	1/4	62	2 x 2	1/2	73	3 x 3	1 1/2
52	1 1/4 x 1	1/4	63	2 x 2	3/4	74	3 x 3	2
53	1 1/2 x 1 1/2	1/4	64	2 x 2	3/4	75	3 x 3	1
54	1 1/2 x 1 1/2	1/3	65	2 x 2	1	76	3 x 3	1 1/2
55	1 1/2 x 1 1/2	1/2	66	2 x 2	1 1/2	77	3 x 3	2
56	1 1/2 x 1 1/2	3/4	67	2 1/2 x 2 1/2	1/2	78	3 x 3	3
57	1 1/2 x 1 1/2	3/4	68	2 1/2 x 2 1/2	3/4	79	3 x 3	5
58	1 1/2 x 1 1/2	1 1/2	69	2 1/2 x 2 1/2	1	80	2 x 2	3
59	1 1/2 x 1 1/2	2	70	2 1/2 x 2 1/2	1	81	2 1/2 x 2	5
60	2 x 1 1/2	3	71	2 1/2 x 2 1/2	1 1/2			

Fig. 6. Key chart for use in selecting proper size for 1750 rpm pump.

In figuring static head, let us assume that it equals 5 ft. Make the following additions in feet head:

Pipe friction loss	16 ft head
Known pressure drop	35
Static head	5
Total dynamic head (TDH)	56 ft

Pump Selection

In selecting the best pump, it should be noted that a 3500 rpm unit is more efficient and considerably less expensive than a 1750 rpm pump for the same rating. In most cases the higher noise level of 3500 rpm motors which is transmitted through the shaft to the pump can be reduced to an acceptable level by using insulated pipe hangers, flexible rubber hose connections on suction and discharge of pump, and a cork or rubber pad under the pump at less cost than that of a 1750 rpm unit. In extreme cases, where these devices cannot be economically applied, it would be best for the engineer to select a 1750 rpm pump.

The 3500 rpm pump can be selected by using Fig. 5 as a guide. For example, the required pump must deliver 45 gpm at 56 ft TDH. Enter the chart at 45 gpm and move vertically to the point representing 56 ft head. This point falls within the space marked by Key No. 11. From the table of Fig. 5, the corresponding pump is a 1 by 1-inch unit with a 1 hp motor. The first figure in this designation (tables with Figs. 5 and 6) refers to the suction pipe size and the second to the discharge pipe size. Consequently, for this problem, the pump has a 1-inch suction and a 1-inch discharge.

For selecting the proper 1750 rpm pump, Fig. 6 is used as a guide. Following the same procedure as before, the required rating of 45 gpm at 56 ft TDH lies within the space marked by Key No. 59. The corresponding pump is a 1½ by 1½-inch unit with a 2 hp motor. This pump has a 1½-inch suction and also a 1½-inch discharge.

A quick check on the advisability of using the next larger size pipe can be easily determined by referring to Table 1. For example, with a flow rate of 45 gpm, a

Fittings			Pipe Size																			
			¼	⅜	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12	14	16	18	20	24
Regular 90° Ell	Screwed	Steel	2.3	3.1	3.6	4.4	5.2	6.6	7.4	8.5	9.3	11	13										
		C. I.	...	...	...	...	...	...	...	...	...	9.0	11										
	Flanged	Steel	...	...	.92	1.2	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.3	8.9	12	14	17	18	21	23	25	30
		C. I.	...	...	...	...	...	...	...	...	...	3.6	4.8	...	7.2	9.8	12	15	17	19	22	24	28
Long Radius 90° Ell	Screwed	Steel	1.5	2.0	2.2	2.3	2.7	3.2	3.4	3.6	3.6	4.0	4.6										
		C. I.	...	...	...	...	...	...	...	...	...	3.3	3.7										
	Flanged	Steel	...	...	1.1	1.3	1.6	2.0	2.3	2.7	2.9	3.4	4.2	5.0	5.7	7.0	8.0	9.0	9.4	10	11	12	14
		C. I.	...	...	...	...	...	...	...	...	...	2.8	3.4	...	4.7	5.7	6.8	7.8	8.6	9.6	11	11	13
Regular 45° Ell	Screwed	Steel	.34	.52	.71	.92	1.3	1.7	2.1	2.7	3.2	4.0	5.5										
		C. I.	...	...	...	...	...	...	...	...	...	3.3	4.5										
	Flanged	Steel	...	...	.45	.59	.81	1.1	1.3	1.7	2.0	2.6	3.5	4.5	5.6	7.7	9.0	11	13	15	16	18	22
		C. I.	...	...	...	...	...	...	...	...	...	2.1	2.9	...	4.5	6.3	8.1	9.7	12	13	15	17	20
Tee-Line Flow	Screwed	Steel	.79	1.2	1.7	2.4	3.2	4.6	5.6	7.7	9.3	12	17										
		C. I.	...	...	...	...	...	...	...	...	...	9.9	14										
	Flanged	Steel	...	...	.69	.82	1.0	1.3	1.5	1.8	1.9	2.2	2.8	3.3	3.8	4.7	5.2	6.0	6.4	7.2	7.6	8.2	9.6
		C. I.	...	...	...	...	...	...	...	...	...	1.9	2.2	...	3.1	3.9	4.6	5.2	5.9	6.5	7.2	7.7	8.8
Tee-Branch Flow	Screwed	Steel	2.4	3.5	4.2	5.3	6.6	8.7	9.9	12	13	17	21										
		C. I.	...	...	...	...	...	...	...	...	...	14	17										
	Flanged	Steel	...	...	2.0	2.6	3.3	4.4	5.2	6.6	7.5	9.4	12	15	18	24	30	34	37	43	47	52	62
		C. I.	...	...	...	...	...	...	...	...	...	7.7	10	...	15	20	25	30	35	39	44	49	57
180° Return Bend	Screwed	Steel	2.3	3.1	3.6	4.4	5.2	6.6	7.4	8.5	9.3	11	13										
		C. I.	...	...	...	...	...	...	...	...	...	9.0	11										
	Regular Flanged	Steel	...	...	.92	1.2	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.3	8.9	12	14	17	18	21	23	25	30
		C. I.	...	...	...	...	...	...	...	...	...	3.6	4.8	...	7.2	9.8	12	15	17	19	22	24	28
	Long Radius Flanged	Steel	...	...	1.1	1.3	1.6	2.0	2.3	2.7	2.9	3.4	4.2	5.0	5.7	7.0	8.0	9.0	9.4	10	11	12	14
		C. I.	...	...	...	...	...	...	...	...	...	2.8	3.4	...	4.7	5.7	6.8	7.8	8.6	9.6	11	11	13
Globe Valve	Screwed	Steel	21	22	22	24	29	37	42	54	62	79	110										
		C. I.	...	...	...	...	...	...	...	...	...	65	86										
	Flanged	Steel	...	...	38	40	45	54	59	70	77	94	120	150	190	260	310	390					
		C. I.	...	...	...	...	...	...	...	...	...	77	99	...	150	210	270	330					
Gate Valve	Screwed	Steel	.32	.45	.56	.67	.84	1.1	1.2	1.5	1.7	1.9	2.5										
		C. I.	...	...	...	...	...	...	...	...	...	1.6	2.0										
	Flanged	Steel	...	...	...	...	...	...	...	2.6	2.7	2.8	2.9	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
		C. I.	...	...	...	...	...	...	...	...	...	2.3	2.4	...	2.6	2.7	2.8	2.9	2.9	3.0	3.0	3.0	3.0
Angle Valve	Screwed	Steel	12.8	15	15	15	17	18	18	18	18	18	18										
		C. I.	...	...	...	...	...	...	...	...	...	15	15										
	Flanged	Steel	...	...	15	15	17	18	18	21	22	28	38	50	63	90	120	140	160	190	210	240	300
		C. I.	...	...	...	...	...	...	...	...	...	23	31	...	52	74	98	120	150	170	200	230	280
Swing Check Valve	Screwed	Steel	7.2	7.3	8.0	8.8	11	13	15	19	22	27	38										
		C. I.	...	...	...	...	...	...	...	...	...	22	31										
	Flanged	Steel	...	...	3.8	5.3	7.2	10	12	17	21	27	38	50	63	90	120	140					
		C. I.	...	...	...	...	...	...	...	...	...	22	31	...	52	74	98	120					
Coupling or Union	Screwed	Steel	.14	.18	.21	.24	.29	.36	.39	.45	.47	.53	.65										
		C. I.	...	...	...	...	...	...	...	...	...	.44	.52										
	Bell Mouth Inlet	Steel	.04	.07	.10	.13	.18	.26	.31	.43	.52	.67	.95	1.3	1.6	2.3	2.9	3.5	4.0	4.7	5.3	6.1	7.6
		C. I.	...	...	...	...	...	...	...	...	...	.55	.77	...	1.3	1.9	2.4	3.0	3.6	4.3	5.0	5.7	7.0
	Square Mouth Inlet	Steel	.44	.68	.96	1.3	1.8	2.6	3.1	4.3	5.2	6.7	9.5	13	16	23	29	35	40	47	53	61	76
		C. I.	...	...	...	...	...	...	...	...	...	5.5	7.7	...	13	19	24	30	36	43	50	57	70
	Re-entrant Pipe	Steel	.88	1.4	1.9	2.6	3.6	5.1	6.2	8.5	10	13	19	25	32	45	58	70	80	95	110	120	150
		C. I.	...	...	...	...	...	...	...	...	...	11	15	...	26	37	49	61	73	86	100	110	140
	Sudden Enlargement		$h = \frac{(V_1 - V_2)^2}{2g}$ FEET OF LIQUID; IF $V_2 = 0$ $h = \frac{V_1^2}{2g}$ FEET OF LIQUID																				

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Fig. 7. Equivalent length for valves and fittings—new straight pipe and turbulent flow only.

2-inch pipe should give a friction head loss of 3.85 ft per 100 ft of pipe. Since the equivalent pipe length is still 115 ft:

$$1.15 \times 3.85 = 4.4 \text{ ft.}$$

The friction loss for 1½-inch pipe was 15 ft; therefore, using 2-inch pipe would reduce the total head by 10.6 ft. The required pump would now be rated 45 gpm at 46 ft TDH.

Referring to the selection guides, Figs. 5 and 6, the 3500 rpm pump would now be 1 by 1-inch with a ¾ hp motor and the 1750 rpm pump would be a 1½ by 1½-inch unit with a 1½ hp motor.

Since the satisfactory operation of any pump is dependent upon the proper sealing arrangement, it is recommended that the pump supplier be furnished with the pH factor, water analysis, description of water treatment, if any, temperature range of water, and limitation of foreign particles. Generally, these factors will not affect the selection of the pump but they will help to insure selection of the proper seal.

Valuable information can be obtained at modest expense of time and money with simple instruments and techniques. This article describes a case in point, where miniature cyclones, less than one inch in diameter, were subjected to field tests which yielded very useful results of sufficient accuracy for many industrial design purposes.

Experiments with Miniature Cyclones

JOHN L. ALDEN
Consultant

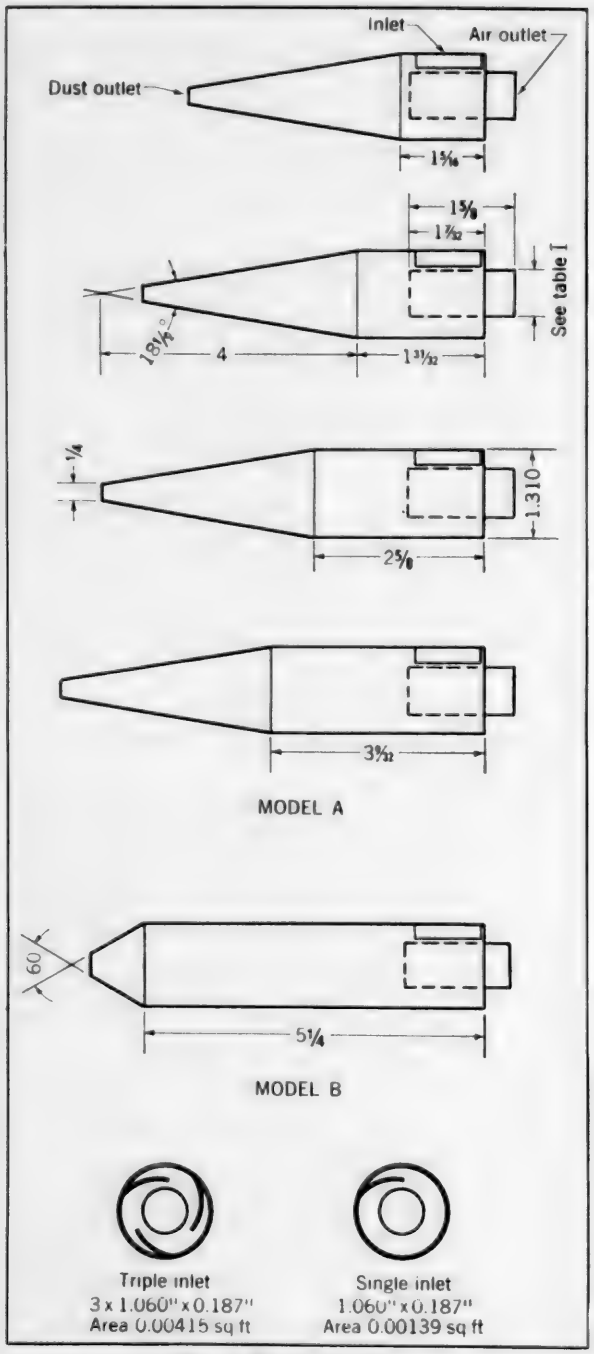


Fig. 1. The test cyclones.

THE purpose of the work about to be described was to determine the influence of various configurations and dimensions on the pressure drop through very small cyclones and on their capacities. The variables whose influences were examined are: (1) the proportions of the cone, (2) the length of the cylindrical body, (3) the area of the inlet and, (4) the area of the air outlet.

Two styles of cyclone were studied, one having a long steeply tapered cone attached to a relatively short cylindrical body and the other having a short blunt cone and much longer body. These are illustrated in Fig. 1 and are designated as Models *A* and *B* respectively.

The included angle of the Model *A* cone was 18½° and that of the Model *B*, 60°. They were machined from solid stock to about a 25 micro-inch finish. The inside diameter of the bodies of all of the cyclones was 1.310 inches. They were smooth and uniform and were made from hard-drawn seamless brass tubing.

The Model *A* cyclones were made in four body lengths, 1.0, 1.5, 2.0 and 2.5 diameters long. The only Model *B* body length tested was 4.0 diameters. All of the cyclones were tested with single inlets of 0.00139-sq ft area and all but one with triple inlets having an area of 0.00415 sq ft. Cross sections of the inlets together with their dimensions appear in Fig. 1. Each model was tested with three sizes of air outlet tube of identical length but having diameters of 0.625, 0.692 and 0.830 inches. The essential details of each cyclone are given in Table I.

In operation, the cyclones are to be horizontally mounted in clusters and are to be fed from a gravity settling chamber. For this reason the test cyclones were mounted similarly with horizontal axes and the inlets were supplied from a chamber in which the approach velocities ranged from about 200 to 700 fpm. In each instance the cyclone discharged its dust into a sealed glass jar, while the cleaned air was discharged into the atmosphere.

The general arrangement of fan, cyclone, and dust receptacle appears in Fig. 2. The pressure drop through the cyclone was measured in the chamber from which the air enters the cyclone inlet. The pressure tap is designated as H_B in the illustration. Air volume was measured by means of sharp-edged orifices located at

TABLE I—DIMENSIONAL CHARACTERISTICS OF TEST CYCLONES.

Model and Number	Cone Angle, Degrees	Body Length, Dia	Inlet		Outlet	
			No.	Area, Sq ft	Dia, Inches	Area, Sq ft
A-1	18½	2½	1	0.00139	0.625	0.00213
A-2	18½	2	1	0.00139	0.625	0.00213
A-3	18½	1½	1	0.00139	0.625	0.00213
A-4	18½	1	1	0.00139	0.625	0.00213
A-5	18½	2½	1	0.00139	0.692	0.00261
A-6	18½	2½	1	0.00139	0.830	0.00376
A-7	18½	2	1	0.00139	0.830	0.00376
A-8	18½	1½	1	0.00139	0.830	0.00376
A-9	18½	1	1	0.00139	0.830	0.00376
A-10	18½	2½	3	0.00415	0.625	0.00213
A-11	18½	2½	3	0.00415	0.830	0.00376
B-1	60	4	1	0.00139	0.625	0.00213
B-2	60	4	1	0.00139	0.692	0.00261
B-3	60	4	1	0.00139	0.830	0.00376
B-4	60	4	3	0.00415	0.625	0.00213
B-5	60	4	3	0.00415	0.830	0.00376

the entering end of the fan inlet pipe. The orifice coefficient was taken as 0.60. Orifice pressure drop was measured at the tap H_S. The manometers were vertical U-tubes filled with distilled water. Their scales were graduated in 1/20-inch units and water levels could be estimated readily with an accuracy of 0.20 inches or better.

The test methods were of less than laboratory precision but were entirely adequate for the purpose. Qualitative results were reliable and the quantitative results are believed to be quite good as evidenced by the consistency of values and their repeatability. The narrow scatter of the observational points in Figs. 3 to 6 bears out this view.

Figure 3 (top) compares pressure drops through single inlet cyclones having various sizes of air outlet. All

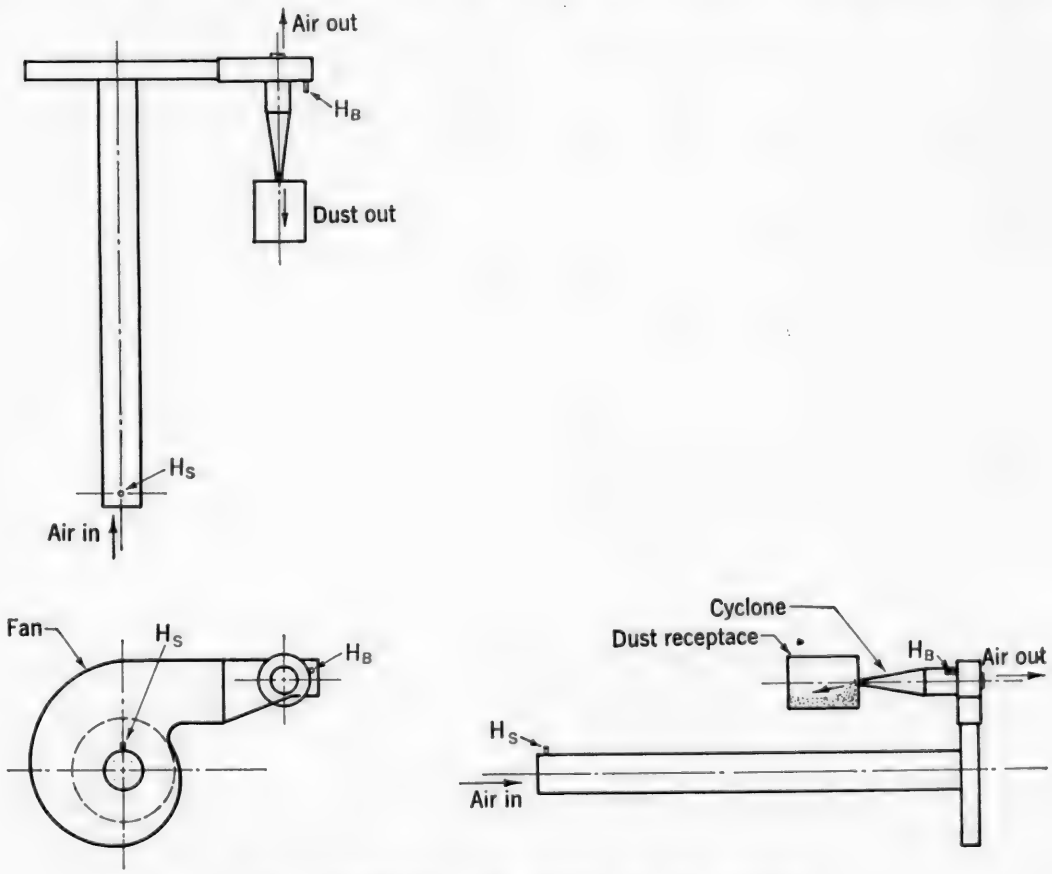


Fig. 2. Arrangement of fan, cyclone, and dust receptacle.

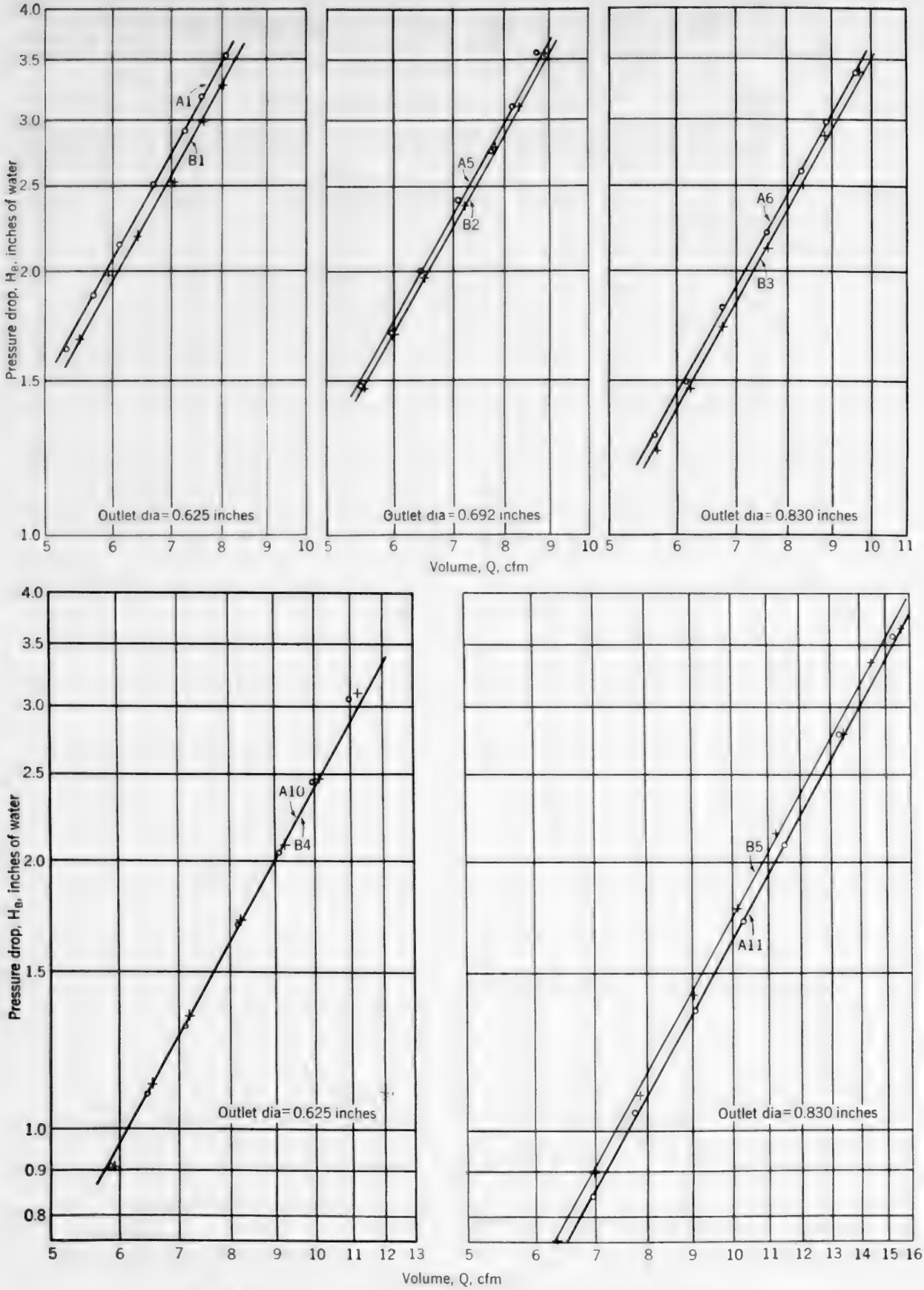


Fig. 3. Pressure drops through single (top) and triple (bottom) inlet cyclones.

of the Model *A* cyclones had body lengths of 2½ diameters. It will be noted that the pressure drop through the Model *A* cyclones is slightly higher in each case than that of the Model *B*. Fig. 3 (bottom) compares triple inlet versions at air outlet diameters of 0.625 and 0.830 inches respectively. The points for the two tests with the 0.625 inch outlet are so close together that a single line fits both sets of points equally well. When the outlets were enlarged to 0.830 inches, the long cone form, Model *A*, showed the lower pressure drop. Why this should be is not clear at this time. Further work to develop the answer is required.

For ease of comparison the curves of Fig. 3 have been combined in Fig. 4 with the observational points omitted for sake of clarity.

The effect of body length on the performance of Model *A* was investigated. As Fig. 5 clearly shows, the longer bodies exact lower pressure drops than do the shorter bodies. This is true for both the 0.625- and 0.830-inch outlets. From the results of these tests it was concluded that no additional information of value would be obtained by duplicating them in the triple inlet style or with the 0.692-inch outlet. Several months earlier, however, a pair of cyclones having an outlet of this size were tested with triple inlets of a larger size, 0.00481 sq ft. Although the values cannot be compared readily with those of the other tests they are shown in Fig. 6 as a matter of interest.

Some incidental observations were made which are of qualitative interest only. For example, a trial was made to determine the effect on the pressure drop of an obstruction near the exit end of the air outlet tube. A flat plate was advanced toward the outlet until the manometer showed an increase in back pressure. It was found that the plate could approach the outlet to a distance of about 0.6 diameters before the water column showed the slightest movement.

The nature of the flow from the air outlet was exam-

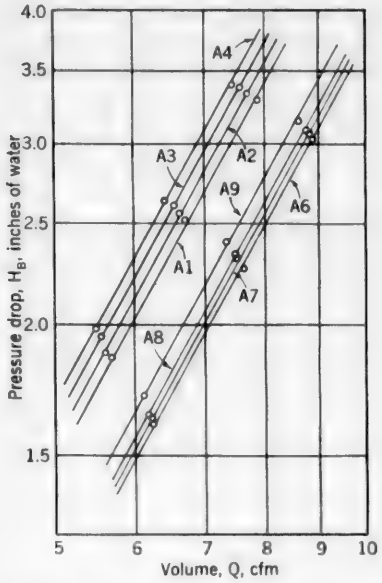


Fig. 5. Effect of body length on performance of single inlet cyclones.

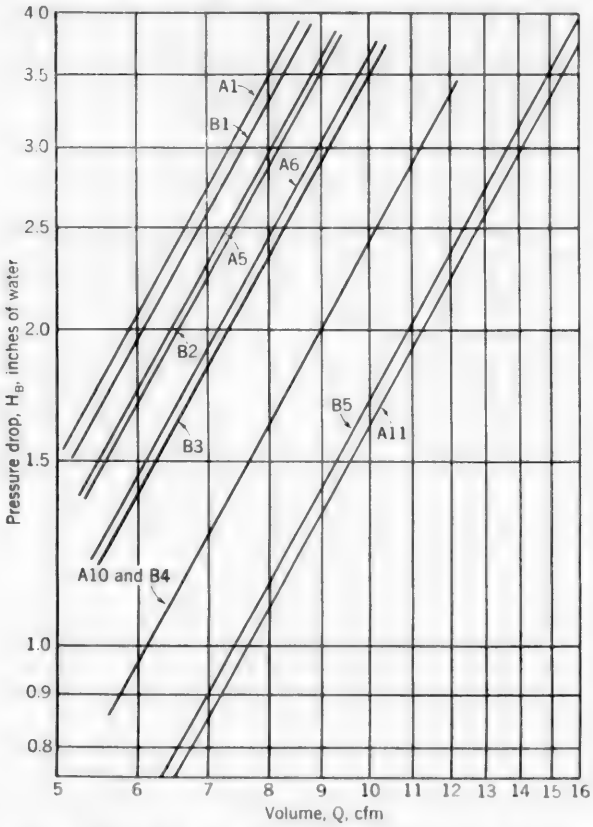


Fig. 4. Curves of Fig. 3 combined for convenient comparison of pressure drop data.

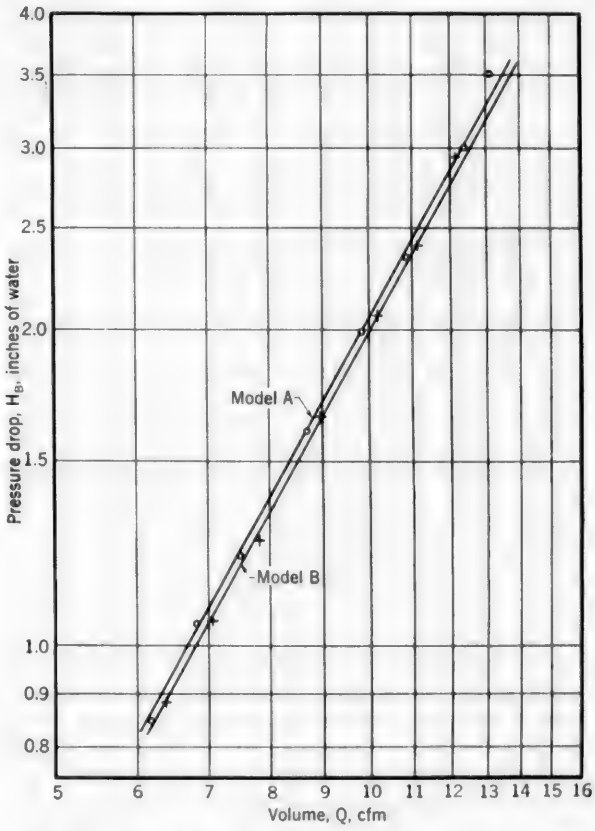


Fig. 6. Effect of body length on two triple inlet cyclones of larger size.

ined casually using a small impact tube and portable manometer. It is well known that the flow in the outlet is strongly helical because it is an extension of the inner vortex of the cyclone. The angle of the stream appeared to be about 30° with the plane of the outlet when the impact tube was held tangent to the rim of the outlet. The impact pressure was about 0.6 inches of water corresponding to a velocity of about 3100 fpm. During this run the average axial outlet velocity (volume/area) was 2160 fpm. Exploring the plane of the outlet still further, a central dead area about ¼ inch diameter was found. No effort was made to determine whether there was inward flow through this area as is often the case in large cyclones.

Ordinary wheat flour was fed to several of the cyclones. It left a distinct pattern on the polished cones of Model *A* devices but no pattern was discernible in the bodies or in the 60° cone of Model *B*. In the 18½° cones the spiro-helical trace advanced toward the apex with a constantly decreasing pitch. Thus, the first convolution, starting from the junction of the body and cone, was completed in about 2.1 inches of cone length. The remaining path to the dust outlet was somewhat more than ¾ of a complete convolution and was achieved in about one inch of cone length. The trace is faint and its origin difficult to identify at the large end of the cone but it becomes narrower and thicker as the exit opening is approached. Judged by eye, the dust travels from body to outlet in 1¾ to 1⅞ turns.

It is believed that the dust whirls in a thin sheet in the cylindrical body, gradually concentrating in a rope-like stream as it advances through the cone. It emerges from the dust outlet tangentially and most of it discharges through a zone embraced by not more than ¼ of the periphery of the outlet. This was clearly evidenced by the heavy deposit on the wall of the dust receptacle covering a band of about 90° in length. The position of the deposit was tangent to the dust outlet in the zone of departure of the dust particles from the cone.

Conclusions

1. Field testing methods yield sufficient accuracy for many industrial purposes. Valuable information can be obtained at modest expense of time and money using simple instruments and techniques.

2. Inlet area has a marked effect on pressure drop and capacity. Trebling the area cut pressure drop by one half. In terms of capacity, the volume at a given pressure drop increases 50%.

3. The outlet area significantly affects performance. Increasing the area by 75% reduced the pressure drop by about one third. The corresponding increase in capacity at constant pressure drop was about 25%.

4. The effect of the body length or of the overall length is not great. A reduction of about 30% overall increased the pressure drop by about 10% and reduced the capacity at constant pressure drop by about 10%. When space is at a premium, not much is lost by shortening the cyclone provided sufficient length remains to prevent objectionable re-entrainment of dust.

5. Slenderness of the cone or the distribution of the overall length between the cone and the body appears to be of minor importance from the standpoint of pressure loss or capacity.

Preventing Steam Boiler Explosions

The greatest cause of steam boiler explosions, says Edward J. Benesch, vice-president and chief engineer of Syska & Hennessy, Inc., New York consulting engineers, is probably low water level.

In a steam boiler, space within the shell is occupied by water in the lower portion and steam in the upper portion. Should the water "disappear" from the boiler and firing still continue so that the boiler becomes dry, water fed into the hot, dry shell will flash into steam instantaneously. The steam may be generated at a greater rate than the safety valve can release it. If the pressure builds up beyond the designed pressure of the boiler (which includes a safety factor) the boiler will burst. Or, the water striking the hot shell or walls will cause them to contract suddenly and crack open.

No automatic safety devices are absolutely foolproof, so the safety or relief valve should be popped by the lever provided and the electric pressure switch tested frequently.

For mechanically fired boilers, an automatic low-water cutoff should be provided. This device, which instantly stops the burner or stoker when the water in the boiler drops below the predetermined safe working level, should be tested at *frequent intervals*.

Low-water cutoffs are available which also automatically feed water to the boiler to maintain normal operating water level. They, too, should be tested frequently.

Oil or gas explosions are caused by the ignition of an accumulation of oil vapor or gas in the presence of air.

Gas ignition should take place at the instant the gas enters the furnace. Should it be delayed, thereby allowing gas to accumulate in the furnace, an explosion occurs.

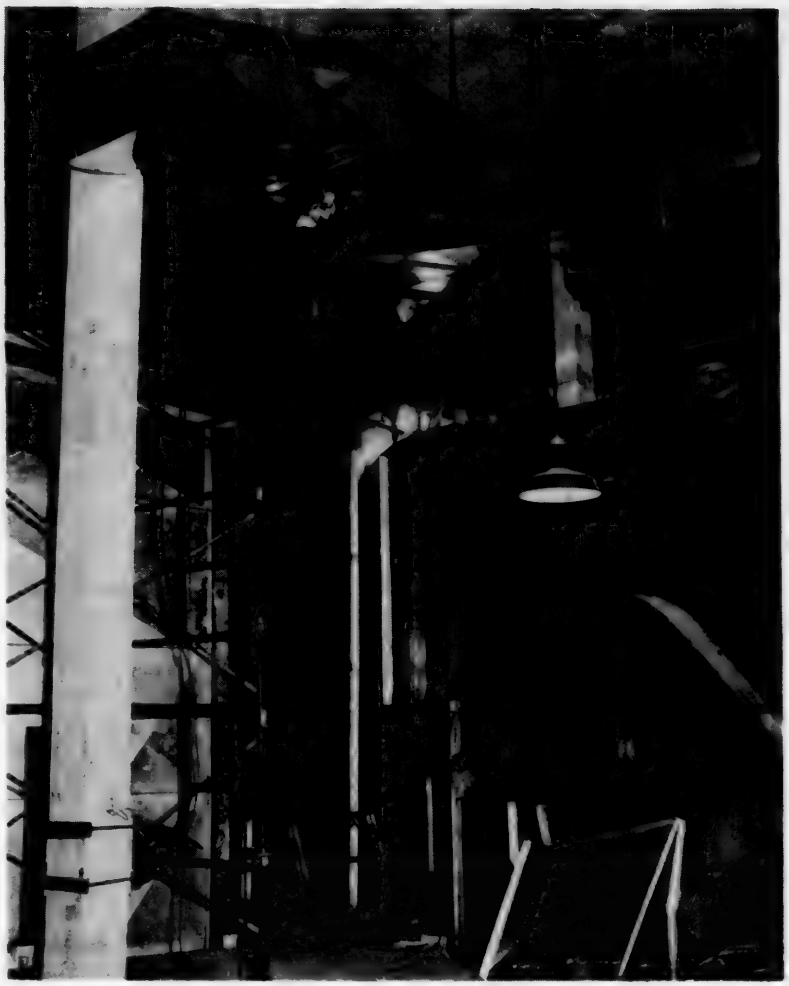
Oil to the furnace must be supplied as a mixture of a fine spray and air in order to burn. Delayed ignition, here also, will result in an explosion unless safeguards are provided.

To guard against delayed ignition for residential size boilers, a *pyrostat*, an electric switch whose contacts are operated by a thermostatic element, is provided. Upon demand for heat by the thermostat, the switch is energized, permitting the burner to operate. If, after a predetermined interval of time, the portion of the switch in the smoke pipe does not become hot, the switch opens and stops the burner.

The pyrostat for flame failure protection is not used on large boilers because its sensing element is small and its location would be too far from the fire. Instead, a photo cell type control is used. The photo cell "sees" the main flame, whereas the pyrostat "feels" the temperature of the flame.

A detector also is provided for the gas pilot flame. The burner will not start should the pilot flame be out or not of the right size to ignite the oil or gas properly.

Automatic controls and burners are built for hard wear, but *they must be inspected and maintained in proper working condition*, Mr. Benesch emphasizes.



Workmen install a section of galvanized sheet steel ductwork for the large air conditioning system of the Spokane Coliseum, Spokane, Washington. Photo courtesy of Bethlehem Steel Company, Bethlehem, Penna.

How to Calculate

Pressure Regain in a Duct System

JAMES W. MAY
Director of Technical Training
American Air Filter Co., Inc., Louisville, Kentucky

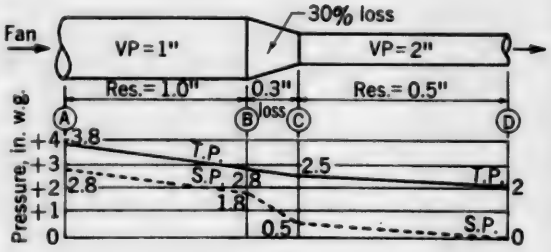
Note: The dimensions of all pressures in this article are in inches of water column, gage. To clarify the presentation, these dimensions are omitted in the text. Also, static pressure, velocity pressure, and total pressure are abbreviated to SP, VP, and TP.

REGAIN of pressure in a duct system is possible because static pressure and velocity pressure are mutually convertible. As a general rule, this conversion is accompanied by some energy loss, the amount of this loss being a function of the geometry of the transition piece (the more abrupt the change in velocity, the greater the loss) and depends upon whether air is accelerated or decelerated. In most handbooks, loss is expressed as a percentage of difference between velocity pressures in the entrance and the exit of the transition piece. One minus the loss, expressed as a decimal fraction, is the efficiency of the energy conversion, or *regain*.

The following examples illustrate the influence of regain on static pressure in various typical duct arrangements. In each example total pressure and static pressure are plotted in order to show their relationship at various points in each system.

EXAMPLE 1

Duct work located on *discharge* side of fan.
Velocity transfer from *low* to *high*.



Overall resistance of the system is the sum of the individual resistances = 0.5 + 0.3 + 1.0 = 1.8.

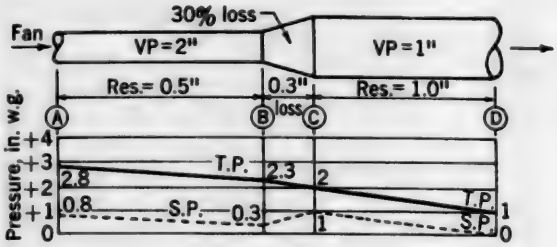
Static pressure at the fan discharge will equal the total resistance of the duct work plus any additional static pressure required for conversion into velocity pressure. Since velocity pressure at *D* is 2, as compared to only 1 at the fan discharge, the *additional* static pressure required for conversion into velocity pressure is therefore 1. Static pressure at the fan outlet, *A* then becomes 1.8 + 1 = 2.8.

Total pressure at any point is made up of velocity pressure at the *discharge* end of the duct (point *D*) plus duct losses up to that point. Total pressure at *A* is therefore 3.8 and consists of the 2 VP at the duct discharge plus the 1.8 of duct resistance. The relationship between SP and TP at each point in the system is as indicated.

Air horsepower generated by the fan is a function of the quantity of air being handled and the pressure developed, and is usually based upon total pressure. In this example, TP at the fan inlet is assumed to be 0 because there is no duct work indicated. Air horsepower supplied by the fan would then equal CFM × 3.8/6356 (for standard air). All values are positive in sign because they are measured above atmospheric pressure.

EXAMPLE 2

Duct work located on *discharge* side of fan.
Velocity transfer from *high* to *low*.



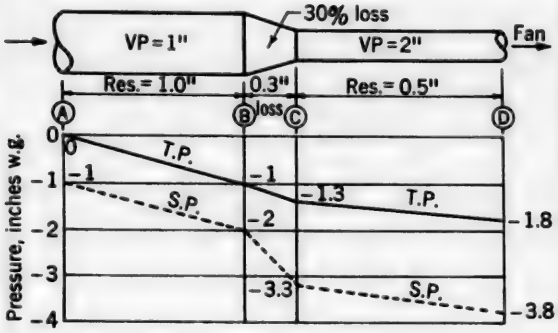
The overall duct system is identical with that shown in Example 1, so the resistance again equals 1.8. At *C*, static pressure equals 1 and the velocity pressure equals 1. In moving from *B* to *C*, the air slows down from a VP of 2 to a VP of 1 and the difference of 1 in the velocity pressure is available for conversion into static pressure between *B* and *C*. If the transition in flow from *B* to *C* took place with no loss (100% regain), the SP at *B* would be 1 − 1 = 0. However, the energy transfer is only 70% efficient (0.3 loss). Therefore, SP at *B* equals 0 + 0.3 = 0.3.

Total pressure at the fan discharge is equal to 2.8, which again consists of 1 VP at the *duct discharge* (point *D*) plus the 1.8 duct resistance. Assuming no suction duct, TP at the fan inlet equals 0, so overall TP of the fan is 2.8. Air horsepower would be determined in the conventional manner.

Particular attention is called to the fact that for the same volume of air, the air horsepower is less in Example 2 than in Example 1, although duct resistance is the same in each case. This difference in AHP is, of course, due to the velocity pressure component of total pressure. In Example 1, the air had a velocity pressure of 2 at the point of discharge from the duct. In Example 2, discharge velocity pressure is only 1 and this difference in discharge velocity pressure accounts for the lower air horsepower in Example 2. Again, it will be noted that TP at any point in the duct system includes the VP at the discharge end of the duct plus the duct losses up to that point. As indicated, total pressure at *A* consists of the VP of 1 at the duct discharge plus the 1.8 duct resistance, or a TP of 2.8.

EXAMPLE 3

Duct work located on *suction* side of fan.
Velocity transfer from *low* to *high*.

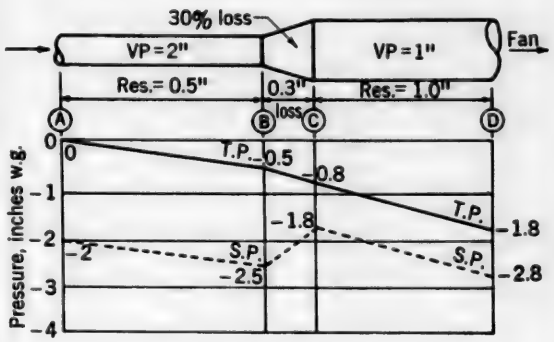


On the suction side of a fan, total pressure is a measure of overall resistance to air flow. In this example, total resistance again adds up to 1.8, the same as it did when the ductwork was on the discharge side of the fan as shown in Examples 1 and 2. Static pressure at the fan inlet, point *D*, is equal to the velocity pressure at the *fan inlet* plus the total resistance to that point. This adds up to 3.8. Since we are working on the suction side of the fan, pressures are negative in sign, or below atmospheric.

In going from *B* to *C*, air is accelerated and velocity pressure is shown as being doubled. Additional energy required by the higher velocity pressure is supplied at the expense of the static pressure. Therefore, SP at *C* is lower (remember, it is negative) than SP at *B* by the amount of transition loss *plus* the difference in VP at the entrance and exit of the transition piece, or lower by 1.3. Air horsepower generated by the fan is again a function of the total pressure across the fan. Since most fans have approximately the same inlet and discharge area, it will be assumed that the velocity pressure at the fan discharge is also 2, which will then be the total pressure on the discharge side of the fan. Total pressure developed by the fan is then equal to the total pressure at the fan discharge plus the total pressure at the fan inlet (disregarding the sign) or 3.8. It will be noted from the diagram that this is also the value of the static pressure at the fan inlet. This circumstance is due to the fact that inlet and discharge areas of the fan were assumed to be equal. Air horsepower is the same as in Example 1.

EXAMPLE 4

Duct work located on *suction* side of fan.
Velocity transfer from *high* to *low*.



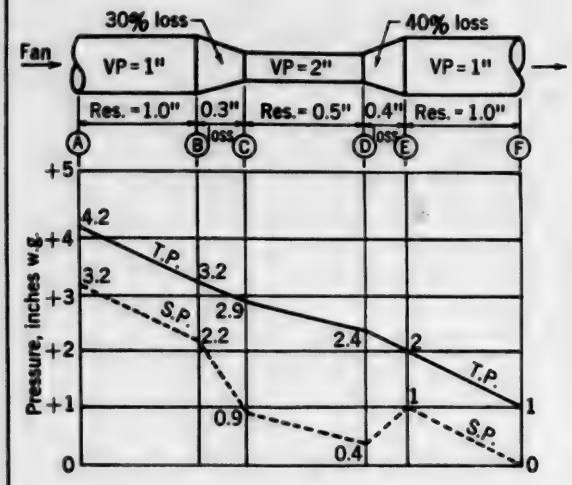
In this example, the only ductwork encountered is again located on the suction side of the fan and total pressure is a measure of the sum of the individual resistances, or 1.8. SP at the fan inlet, *D*, is equal to the VP at the *fan inlet* plus the duct resistance (or total pressure) up to that point. This amounts to 2.8 and is, of course, negative in sign, as it is on the suction side of the fan.

In going from *B* to *C*, the air slows down, as indicated by the difference of 1 in the VP at these two points. This difference is available for conversion into static pressure from *B* to *C*. If the transition from *B* to *C* were accomplished with no loss (100% regain) SP at *C* would be $-2.5 + 1.0 = -1.5$. Since the energy transfer is only 70% efficient (0.3 loss) SP at $C = -1.5 + (-0.3) = -1.8$.

Again, air horsepower developed depends upon the TP supplied by the fan. Assuming velocity pressure in the fan discharge to be 1 (the same as at the fan inlet), TP *across* the fan will be 2.8. Again, it will be noted that this is equal in value to the static pressure at the fan inlet. The air horsepower is the same as indicated in Example 2.

EXAMPLE 5

Duct work located on *discharge* side of fan. Velocity changes as indicated.



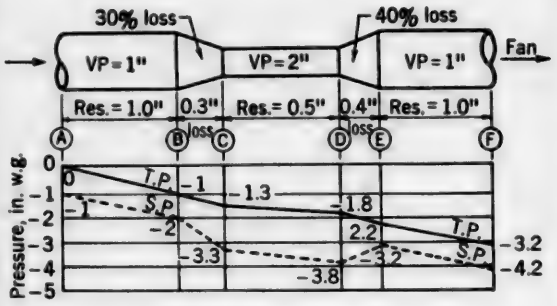
From the sketch, the ductwork is again located all on the discharge side of the fan. Total pressure at the fan discharge (point *A*) is equal to the velocity pressure at the *discharge end* of the duct (point *F*) plus the accumulated resistances. These add up to 1.0 + 1.0 + 0.4 + 0.5 + 0.3 + 1.0 = 4.2.

Static pressure regain between *D* and *E* is identical to the situation encountered in Example 2. If there were no energy loss in the transition piece, static pressure at *D* would be 0, because the difference in VP of 1 would show up as static pressure regain. However, the transition is only 60% efficient which means a loss of 0.4, so SP at point *D* = 0 + 0.4 = 0.4.

Conversion of static pressure into velocity pressure between *B* and *C* is the same as occurred in Example 1. There must be sufficient static pressure at *B* to furnish the additional velocity pressure required at *C*. In addition, transformation of energy between these two points is accompanied by a loss of 0.3. Since SP at *C* equals 0.9, SP at *B* = 0.9 + 0.3 + 1.0 = 2.2. Air horsepower developed by the fan would be calculated in the conventional manner. Since there is no ductwork on the suction side of the fan, total pressure against which the fan is operating will be 4.2.

EXAMPLE 6

Duct work located on *suction* side of fan. Velocity changes as indicated.



Since all the ductwork is on the suction side of the fan, SP at the fan inlet (point *F*) is equal to VP at the *fan inlet* plus the total duct resistance up to that point. This equals −4.2 SP, since static pressure on the suction side of the fan is always negative. The duct system is the same as was used in Example 5 and therefore has the same overall resistance of 3.2. If it is again assumed that the inlet and discharge of the fan are of equal areas, the total pressure *across the fan* will be the same as in Example 5 and in each case the fan will deliver the same air horsepower when handling equal volumes of air.

Static pressure conversion between *B* and *C* is the same as discussed in Example 3. There must be sufficient SP at *B* to furnish the additional VP required at *C*. In addition, the energy transfer between these two points is accompanied by a loss of 0.3. Since SP at *B* = −2, SP at *C* = −2.0 + (−1.0) + (−0.3) = −3.3.

Static pressure regain between *D* and *E* is identical to the situation discussed in Example 4. If there were no loss in the transition piece, the difference of 1 in velocity pressure would all be regained as static pressure at *E* and SP at that point would be −2.8. However, the transition is only 60% efficient (0.4 loss) so the SP at *E* = −2.8 + (−0.4) = −3.2.

Air handling systems involving ductwork on both suction and discharge sides of the fan can be evaluated in the manner just described with each side being considered individually. The overall total pressure or static pressure against which the fan is operating can then be easily determined.

SPECIAL REPORT

HEADQUARTERS, U. S. AIR FORCE REFRIGERATION AND AIR CONDITIONING CONFERENCE

The U. S. Air Force sponsored a conference on Air Conditioning and Refrigeration at Wright-Patterson Air Force Base, Dayton, July 13-16. About 320 attended the meeting, planned to improve the know-how of Air Force design and operating personnel.

This Special Report contains excerpts from five of the many papers presented, the selection having been made on the basis of subjects of primary interest in connection with design.

Mechanical cooling has developed into an important phase of Air Force functioning. Ten years ago the U. S. Air Force could boast of $35 to $40 million dollars worth of mechanical cooling equipment. By 1952 it had built this investment to over $100 million and by 1958 had reached the $400 million dollar mark. By 1960, if the present rate of expansion continues, the Air Force investment in cooling equipment will have reached $500 million.

Ninety per cent of the mechanical cooling in the inventory of the Air Force is used to increase the proper operational capability of mechanical and electrical equipment. About 10 per cent is used for personnel cooling in administrative areas, and about 2 per cent is used for cooling in living quarters.

SIZING AND LAYING OUT FOR EVAPORATIVE COOLING SYSTEMS

ORVEL M. JOHNSTON

Vice President, Wright Manufacturing Company, Phoenix, Ariz.

Steps an engineer should follow for the proper layout and sizing of an evaporative cooling system.

FROM the crude evaporative coolers that many of us knew, great steps have been made in developing the modern evaporative cooler and cooling systems we know today. Evaporative cooling has brought low cost comfort to many parts of the world and has added substantially to the growth of these areas.

Evaporative cooling employs three methods for providing comfort:

1. We must consider the actual temperature drop in the air delivered by the cooler as a result of the evaporative or adiabatic process within the cooler itself. The temperature drop is approximately 80% of the difference between the dry bulb and the wet bulb temperature. Because the difference between the dry bulb and wet bulb temperature diminishes with the increase of humidity, it therefore follows that evaporative coolers operated more efficiently in areas that have a low average humidity.
2. Additional comfort results from the actual movement of air in the area being cooled. This movement across the occupant's skin increases the natural evaporative process resulting in the additional cooling effect as one would receive in standing before an electric fan. This is sometimes referred to as the latent cooling effect.
3. Evaporative cooling employs 100% fresh air and requires that the same air be exhausted from the area being cooled. A complete air change is made in from one to three minutes. Sensible heat conducted from the walls and windows, as well as heat created by electric lights, appliances and other internal sources, is quickly exhausted from the area. This adds to the cooling comfort, and therefore, evaporative cooling has been very successfully employed throughout the country to cool areas that have high heat loads resulting from machinery and other internal heat conditions.

The American Society of Heating and Air Conditioning Engineers as well as other interested parties have done considerable research in recent years on the designing of evaporative air cooling systems. Some very basic and sound methods of calculating air volume requirements and designing air distribution systems have resulted. In designing an evaporative air cooling system, the first consideration is to determine, as nearly as possible, the actual climatic condition of the area; the range and frequency of simultaneous wet bulb and dry bulb temperature readings and other data to assist in determining air design temperatures.

Next determine the sensible heat load of the building or space being cooled. The sensible heat is heat transmission from the roof, walls, doors, windows, etc. The latent heat load is not considered in calculating evaporative cooling volume. The following data is necessary in computing the total sensible heat load:

1. Determine net area of each wall, door, ceiling and glass, keeping tabulation of various exposures as to north, south, east and west separately.
2. Calculate or determine from reference tables the heat transmission coefficient.
3. Determine design temperature differentials.
4. Calculate the heat flow.
5. Determine internal load from occupants, lights, etc.
6. Total summation of heat flow from walls, ceiling, doors, windows and the internal heat load gives the total sensible load.

By using the following air flow formula, the required cfm can be computed.

$$\text{Required air quantities in cfm} = \frac{\text{Sensible heat load, Btu per hour}}{1.08\ (\text{Temp. rise in building})}$$

While this method of determining the air volume requirements is probably the most reliable, it is quite complicated and requires a working knowledge of air conditioning design and calculations. It would appear, therefore, to be good practice to check final sizing results against the commonly known "rule-of-thumb" method of determining the number of air changes per minute required. This method generally requires a three-minute air change in the most arid areas under favorable heat load conditions and increases the air volume to one and one-half air changes per minute under conditions of abnormal internal heat such as large number of people, heat producing machinery, and in areas with high humidity conditions. A commonly used method is based on the relationship between the spread of the wet bulb and dry bulb temperature, and the air change rate.

Time Required for Air Change, Minutes	Approx. Spread—Dry Bulb and Wet Bulb, Deg F
3	30 to 35
2	26 to 30
1½	20 to 25

The drip type evaporative cooler with which I am most familiar and which is predominantly used in the competitive civilian market is relatively simple and inexpensive from the basis of original cost as well as operating cost. It may be interesting to note that low cost evaporative cooling is being used very satisfactorily in areas that are normally considered to have excessive humidity conditions. The cooling system is designed for near maximum heat conditions. The unit is equipped with a two-speed motor and switch which will allow the cooler to operate at approximately two-thirds of its normal air capacity. This allows the user to

Military and industry leaders at the conference, left to right: Rudy Berg, president of Air-Conditioning and Refrigeration Institute; Brigadier General E. B. Cassidy, director of personnel and support operation for the Air Material Command; John H. Spence, international educational director, Refrigeration Service Engineers Society; John M. Ferry, special assistant for installations, Office of the Secretary of the Air Force; Major General A. M. Minton, director of civil engineering, U. S. Air Force; A. E. Manning, president of RSES; Arthur J. Hess, president, ASHRAE. For news report of conference, see August issue, ACH&V, p. 12.

select a lesser volume of air at night and during the early and late part of the cooling season when the weather is comparatively mild. Also, in common use is the separate manual switch which allows the water supply in the cooler to be cut off, as well as the automatic humidistat that automatically cuts off the water supply when the relative humidity rises to a certain point. This enables the system to be operated as an air circulator or ventilator at night and at times when the humidity rises to render the air temperature drop ineffective. In most areas during the hot part of the day, the humidity is sufficiently low to allow the cooler to operate quite efficiently. In the evenings as the relative humidity rises, the water supply can be cut off on the cooler so it operates as a ventilator.

After the necessary air volume for the space to be cooled is determined, the next step is to design an air distribution duct system that will efficiently and effectively distribute the air. Possibly, a more efficient plan is to zone the space to be cooled, using multiple units and shorter duct runs. Evaporative coolers should be located as close to the space to be cooled as possible, but it should be located on the exterior of the building with complete exposure to fresh air. It should be readily accessible to service. After the cooling unit is located, tentative duct layouts must be made, with all branch ducts. Each branch duct must show the required cfm to be delivered.

Air duct systems for evaporative cooling usually run through the attic with ceiling air diffusers, or through furred-down hall or closet spaces with wall air registers. Both diffusers and registers should be of the proper type and size to give adequate air distribution without air noise. Important, too, is that all registers should be located, if possible, opposite from where the air is to be discharged. It is important that the evaporative cooling duct system be designed so every elbow has an adequate radius, that transitions from one size duct to another are streamlined and not abrupt, and that branch duct be scrolled-off the main duct with adequate radius to avoid dynamic air loss and excessive noise.

Air volume requirement for the space to be cooled, plus the static pressure loss of the duct system, will give the information necessary to select the proper size cooler. The cooler should have rated volume necessary to overcome internal static of the unit itself as well as external static, and able to deliver the required air volume. It is important to select a cooler designed to give a minimum of 80% of dry and wet bulb temperature differential.

Movement of a large volume of air is requisite to successful cooling by an evaporative system; therefore, ducts must be of sufficient size and designed to distribute the air without excessive noise and static pressure loss. To keep the noise level at a minimum, the fan outlet velocity of the cooler should be kept as low as practicable. Experience has proven that with well designed duct systems, the fan velocity can go up to 1600 fpm for static pressures from 0 inch to 5/8 inch with very satisfactory results. The noise level in the room being cooled depends not only on the sound power output of the fan unit, but also upon the sound attenuation of the duct system and the room's size and sound absorption qualities.

Adequate openings must be provided to exhaust the air from the space or room being cooled. Not less than 2 sq ft of free outlet area should be provided for each 1000 cfm entering the room. Inadequate provision to exhaust air will reduce seriously the cooling job of a system.

1. It will create back pressure or static pressure against the fan and reduce the volume of air delivered.
2. It will permit humidity build-up in the room. If the air is freely exhausted, this will not occur.
3. Air movement in the room is reduced.
4. Exhausting of the sensible heat is reduced.

The principle steps to take in sizing and laying out evaporative cooling systems is summarized as follows:

1. Determine design temperatures.
2. Determine sensible heat loss.
3. Calculate cfm requirement.
4. Determine location of cooler.
5. Determine duct size.
6. Determine proper size and location of air registers.
7. Determine cooler size.
8. Provide for adequate exhaust.

Nearly every evaporative cooling job is different and it is up to the engineer to apply the principles suggested here and to use other available information in designing each particular job. By following approved methods of sizing and lay-out evaporative cooling systems, together with sound judgment resulting from experience, the best possible evaporative cooling job will result.

OPERATORS' MANUAL PREPARATION IS A DESIGN RESPONSIBILITY

W. N. MEYER

Chief, Mechanical Branch, Air Force Academy Construction Agency

Since instructions must cover the operation and maintenance of a complete system, only the architect-engineer can prepare the manuals. Contractors are not qualified for this job.

THE application of air conditioning has now become so extensive and so diversified that we can no longer leave procedure to the discretion of operators. Instead, the time has come when the operating procedures must be designed into the system, and this is by no means a new thought. Detailed operation and maintenance instructions are standard for all flight line equipment. The tremendous and complicated chemical and petroleum industry even goes to the extent of building scale models of their plants. Production engineers are then brought in to write operating instructions before the final design is completed and before construction is started. To get the most benefit from the money we spend for extensive air conditioning, it is time that we paid more attention to the methods of operation so that we may receive the full potentiality of our well designed systems.

Past practices have been to hold the contractor and the equipment manufacturer responsible for the furnishing of operation and maintenance manuals and for the training of our operators. This has generally resulted in the accumulation of a large mass of manuals and literature from the manufacturers with no instructions for operating the plant as a whole.

A large contractor generally operates primarily as a broker and coordinator for a number of subcontractors. He is not normally qualified nor staffed to prepare operating instructions, especially for systems designed by someone else. Any requirements in the contract for instructions are therefore passed on to the most convenient subcontractor or supplier. Suppliers are primarily interested in the equipment they furnish and generally not in the system as a whole. The usual assembly of maintenance manuals from various suppliers and manufacturers is generally so massive that it is seldom used by the operator. The most effective instructions are those that are posted in the immediate vicinity of the equipment.

Many Trades Involved

Frequently in the construction of a major facility, neither the contractor nor the manufacturer is able to determine from the plans and specifications exactly what type of operation is intended in the design. Plans and specifications do not always indicate required coordination between trades. We are all aware of the various trades involved in the construction of large refrigeration or air conditioning systems. In our profession we also have considerable specialization and divisions of responsibility. The architect-engineer has virtually completed his job when the plans and specifications are sent out for bids. He is never called in again unless there is an obvious error or unless something does not perform satisfactorily. Next, the contracting officer takes over with the assistance of a construction engineer or inspector. Even if the construction engineer knows considerably about mechanical systems, he is not supposed to redesign the system but is to make sure that it is built in accordance with the plans and specifications. After the construction is completed, the facility is turned over to the operators of the using agency. The operator then has the responsibility of producing a satisfactory end result with the equipment as installed.

AFM 88-8 requires that "The sequence of operation of the automatic controls should be clearly and completely described in the specifications, and should be supplemented with a control diagram on the drawings." I very much doubt, however, whether any of you have had very much success in educating architect-engineers to comply with this requirement.

Graphic Control Panels Installed

For the Air Force Academy, it was recognized during the preliminary stages of design, that complicated systems would be required to produce satisfactory conditions in the occupied space. The architect's concept of the Academy buildings incorporated the extensive use of glass and aluminum. Recommendations to obtain overhangs, shading devices or more favorable orientation were rejected. The size and usage of the buildings is such that many areas are of necessity without natural light or ventilation. Year-round conditioning of the interior spaces therefore became essential. Fortunately extensive mechanical refrigeration is not required because of the availability of cool, dry mountain air. Conditioning of the interior spaces has quite generally been accomplished by supplying more outside air when cooling is needed. Since it was known that the required systems would be complicated, it was decided to handle the operator's problems by preparing comprehensive operating instructions and by installing graphic central control panels in the larger buildings. This would not only provide central control for economy of operation but was the only way to assure intelligent operation. Our contract with the architect-engineer included a requirement that they prepare comprehensive operation and maintenance manuals for all facilities. They, however, were accustomed to obtaining such instructions from the equipment suppliers. After much discussion, it was agreed the specifications would include a requirement that the contractor furnish and post for each unit ventilating system a simplified, consolidated equipment and control diagram with the sequence of operation clearly outlined

on the basis of specific temperatures, pressures and climatic conditions. To retain design engineering control, these instructions were to be submitted for approval prior to posting.

Problems Encountered

The following problems arose as follows:

1. Difficulty was encountered in that the instructions were not submitted until the contractor had completed his installation and supposedly was ready to turn the facility over to the Air Force.
2. Because of the distinct separation of the electrical work from the mechanical work in the plans and specifications, it became a problem as to who would show the electrical interlock and such fundamental things as to how to stop and start a system.
3. It was noted that the specifications did not include the providing of adequate posted instructions for more complicated equipment than unit ventilators. As an example a simplified diagram and posted operating instructions are definitely required for the basic heat exchange and pumping equipment and for refrigeration equipment.
4. The contract plans and specifications did not clearly indicate the manner in which the systems were intended to operate.

Construction Agency Prepares Manuals

Contract drawings normally included control diagrams with details of the component parts, but these were not accompanied by a clear and complete description of the sequence of operation. As a result the control supplier could only adjust system in accordance with his best judgment. We were continually confronted with systems that were not set-up in accordance with the design intent. The most frequent fault has been the overlapping of heating and cooling. Also it was found that toward the completion of the design and construction program, the architect-engineer was not nearly as interested in preparing the operating instructions as he was in preparing the original design. This attitude is not considered peculiar to the designers of the Academy because I believe the attitude will be found almost universal with most private design organizations. They are just not as concerned with the actual operation as those of us who represent the using agency. During the past several months the Air Force Academy Construction Agency rather than the architect-engineer has been preparing the final operation and maintenance manuals for the Academy. Even though we fully recall the design intent, we find it necessary to go back to the design analysis and sometimes recalculate a given set of conditions. We must again review the type and hours of occupancy, the amount of minimum and maximum ventilation requirements and the exact settings of submaster temperature controls. As an example, the original design contemplated definite hours of occupancy but the plans and specifications merely call for an adjustable time clock.

When the desires of the Air Force regarding posting of operating instructions became fully known, the representatives of all the major control manufacturers were most cooperative in satisfying the requirements. They know that the posted instructions will not only be helpful to the regular operating personnel, but that they assure more creditable performance of their equipment and will be a definite aid to their own servicemen in any type of service contract. In showing typical examples of posted operating instructions, the style of the various control manufacturers will no doubt be recognized even though their name does not appear on the reproduction.

Fortunately, it is not necessary that operating instructions be prepared in any exact manner. Our form of presentation has changed and we think improved for the more recent buildings. However, in discussing effectiveness with operators, we find that they consider all of the instructions so much better than anything they have ever received before that they are entirely happy with all of the diagrams and instructions. The thought no doubt occurs to you that the posted instructions are fine but how should Air Force Engineers proceed with getting them for their installations. You may not have much trouble preparing them for yourself for the minor construction program under your control from beginning to end, but I can assure you they will not come easy for systems installed under the major construction program. Contractors and especially architect-engineers doing Government work will need considerable education. In preparing this presentation, the problem of how to handle future Air Force projects has been brought in sharper focus.

CAUSE AND CONTROL OF ODOR IN AIR CONDITIONED SPACES

WARREN VIESSMAN

Mechanical Engineering Consultant for Installations, Headquarters Air Research and Development Command, Andrews Air Force Base

An understanding of the cause and control of odors can result in savings when figuring air conditioning costs.

ODOR is defined as that property of a substance which excites the sense of smell. To be odorous, a substance must be either already in a gaseous or vaporous state, or possess a vapor pressure. When the concentration of odorous vapors in the air is sufficient to permit odor perception, the air is commonly said to be odor-free. Therefore, to eliminate or abate an odor condition, it is necessary either to remove the offending gases or vapors or adequately reduce their concentration.

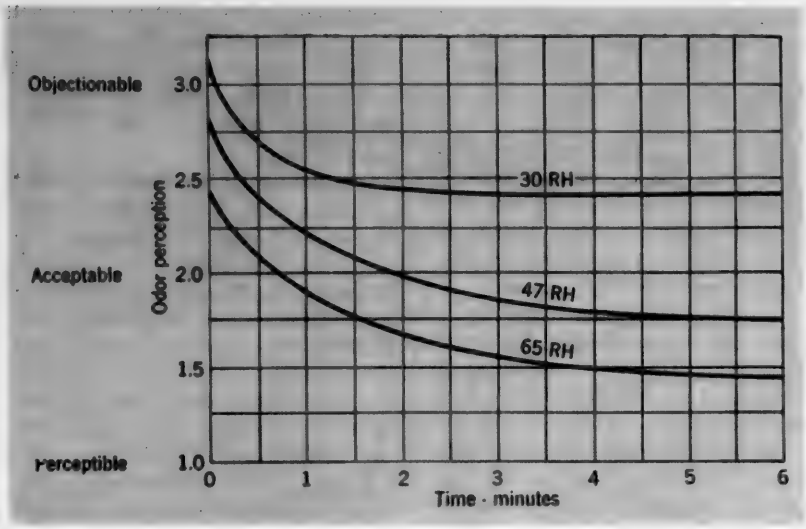


Fig. 1. Odor perception of tobacco smoke; ventilation 70 cfm; 5 cigarettes; 77.3 deg DB.

Odor Sources

In offices, arenas and other inclosed spaces, obnoxious odors may be body and tobacco smoke odors. Cigarette smoking may produce objectionable pyridine and ammonia odors and irritants, and it may impair visibility. Discomforting and toxic odors may be introduced from the outside atmosphere and may contain a high percentage of hydrogen sulphide, industrial effluents or smog. In industrial spaces, the air may contain chemical and product odors such as printing ink, dyes, synthetics and odors from manufactured rubber products. They may also occur from air conditioning coils, for the metals and coatings used materially affect the likelihood of producing objectionable odors.

Odor Evaluation

Odor detection and measurement must ultimately rely upon olfactory observations and human appraisal. A trained organoleptic panel is presently the best method of evaluating odor intensities as the nose is still the best instrument for odor perception. An arbitrary preference scale of increasing odor values is selected. The sensory scale utilized by Yaglou for cigarette smoke classifies odor as: 0, imperceptible; 1, not objectionable; 2, acceptable; 3, objectionable; 4, endurable, and 5, intolerable. This scale has been found convenient for use in air conditioning odor investigations. As discrimination develops with experience, the objective sensory scale can be divided into more steps.

Another method bases odor intensities on multiples of threshold concentrations. In this method a source of odorless air and a method of mixing it in easily variable proportions with the odor sample is used. The mixture is adjusted until the odor can be barely discernible. The result, expressed as the ratio of mixture volume to sample volume is called the number of thresholds. At threshold, or just discernible intensity, the nose is operating at its most sensitive point. The number of thresholds has a useful meaning. For instance, 10 thresholds has the implication that 1 cubic foot of odorous gas can taint 10 cubic feet of air to a recognizable level.

Odors may not only be objectionable but may cause irritation. Tests made by organoleptic panels have indicated that first inhalation or impressions of cigarette smoke have, in the majority of cases, been higher than second or later inhalations. This indicates that perception is affected by adaptation to odor intensity. Adaptability begins immediately and takes place more rapidly during the initial stages of exposure.

Perception intensities as a function of time have been determined by Kerka and Humphreys. A smooth curve indicating trends was developed from the test data and is given in Fig. 1. In the case of irritation, which is confined mostly to the eyes and nose, the investigators found that the irritation increased with time, approximately as shown in Fig. 2.

Humidity and Temperature Effects

Research has indicated that odor perception of cigarette smoke (suspension of tobacco tar droplets plus vapor), and pure vapors are affected by temperature and humidity. An increase in humidity at constant dry bulb temperature has the definite effect of lowering the intensity level of cigarette smoke as well as of pure vapors as shown in Fig. 1. The effect is more pronounced for some odorants than for others. An increase of temperature at constant specific humidity lowers the odor level of cigarette smoke slightly. While the perceptible odor level of cigarette smoke decreases with time of exposure, irri-

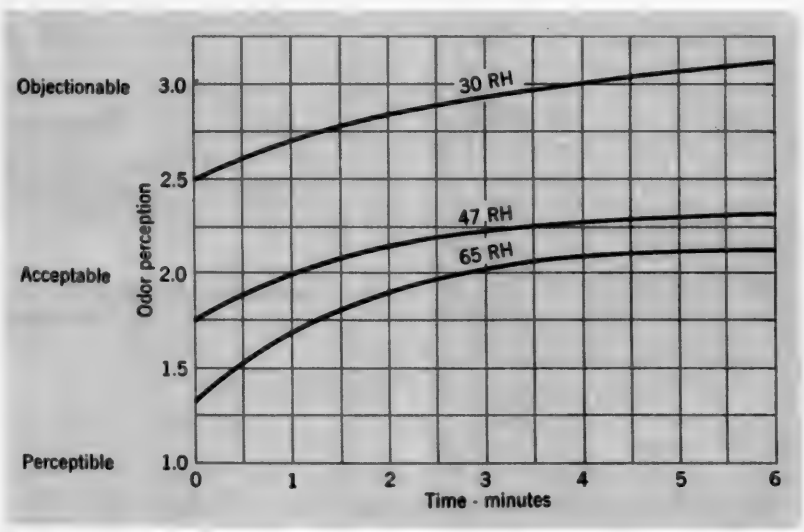


Fig. 2. Irritation by tobacco smoke; ventilation 70 cfm; 5 cigarettes; 77.3 deg

tation to the eyes and nose generally increases. The irritation is greater at low relative humidities, as shown in Fig. 2.

To keep odor perception and irritation at a minimum, the air conditioned space should be designed for about 50 to 55% relative humidity. Since temperature has but slight effect on odor level at constant specific humidity, it can generally be ignored and the temperature maintained for the desired conditions as affected by comfort or economy.

Adsorption and Release of Odors

Tests were made on the odor adsorption and release of environmental materials such as wool, nylon, rayon and fir wood. By using iso-amyl acetate as the odor agent, it was determined that the odor adsorption of rayon was negligible. It did not adsorb enough odorant to be measured by the test methods employed. The odor adsorption at the end of a 24-hour charging period was about the same for nylon and cotton at the same temperature and humidity, Fig. 3. The odor adsorption of wool samples under the same test conditions was less. Adsorption of the wood samples was less than nylon and cotton, but more than wool. At 50% RH, maximum odor adsorption, during the 24-hour loading period, occurs at about 75 deg F for nylon, and is considerably less at 60 and 90 deg, Fig. 4. At 75 deg, odor adsorption during the same period was found to be greater at 50% RH than at 85% RH.

Odor retention or release as a function of airing time is affected by temperature and humidity. For the fabrics tested and for 75 deg 50% RH conditions, odor retention after 1000 minutes was reduced to 6.8% for cotton, 12.3% for nylon and 25.8% for wool. In the latter case the initial wool retention was only about 25% of that of cotton or nylon. After 1000 minutes the odor retention of wool was favorable to that of cotton. Wood lost its odor retention after 300 minutes.

Wood quickly gives up odors adsorbed. Wool has low odor adsorption at all temperature and humidity combinations tested. Nylon and cotton adsorb large quantities of odors at an optimum condition of 75 deg and 50% RH. They act as a sponge, readily adsorbing odors from a tobacco smoke filled room, and releasing them more slowly over a longer period. This indicates that the selection of drapes, floor coverings, etc., are important air conditioning considerations.

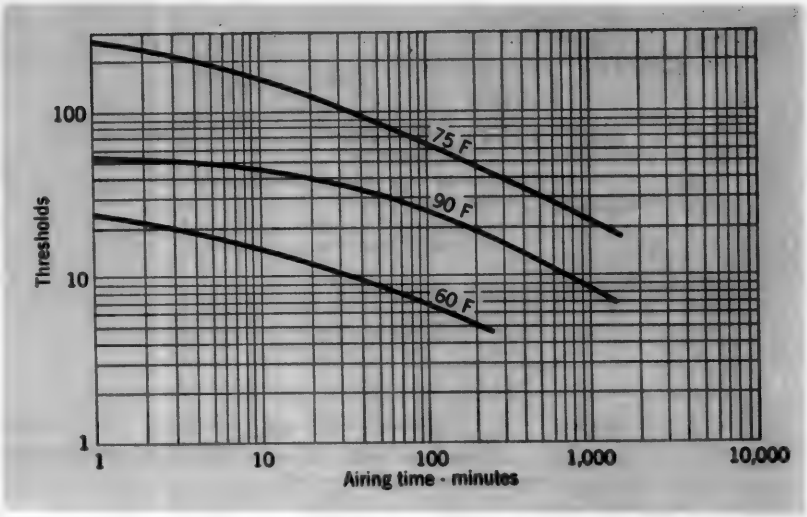


Fig. 4. Odor adsorption for nylon at 50 per cent RH.

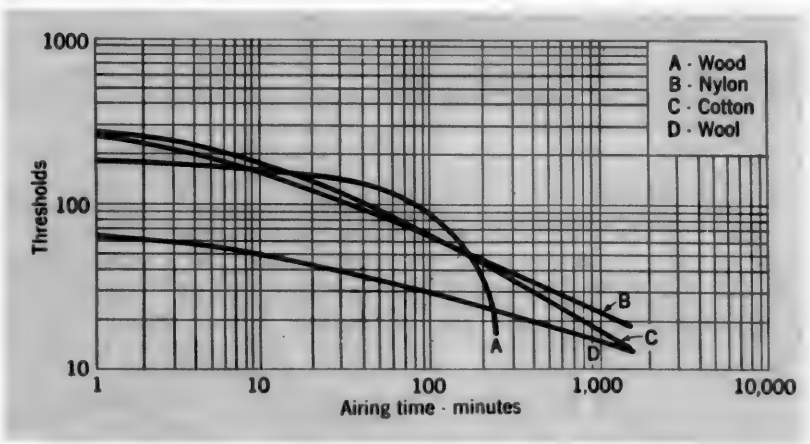


Fig. 3. Odor absorption for four materials.

While it has been shown that smoke, cooking and body odor perception is decreased with humidity increase, where the odor source is intrinsic with the materials, as in the case of linoleum, paint, rubber and upholstery, a reduction of relative humidity would be beneficial, as this would decrease the rate of odor release.

Odor Removal

Odor removal may be accomplished by physical or chemical means. Ventilation with clean outside air, air washing or scrubbing, charcoal adsorption and masking are physical methods available to the engineer. Chemical absorption or destruction of odor sources, vapor neutralization, masking and catalytic combustion are other means. Of these, air washing or scrubbing and combustion are processes of considerable value to process industries. Washing and scrubbing, like filtering are applicable to the removal of particulates and in some cases are means of valuable product recovery. Where odors are associated with the particulates, they are indirectly removed. Combustion of obnoxious gases is quite efficient and practical where indicated by economy. These methods are employed to alleviate the effects of harmful exhaust gases and particulates on health, vegetation and property. Ventilation and charcoal adsorption are effectively and extensively utilized in air conditioning for odor removal by engineers.

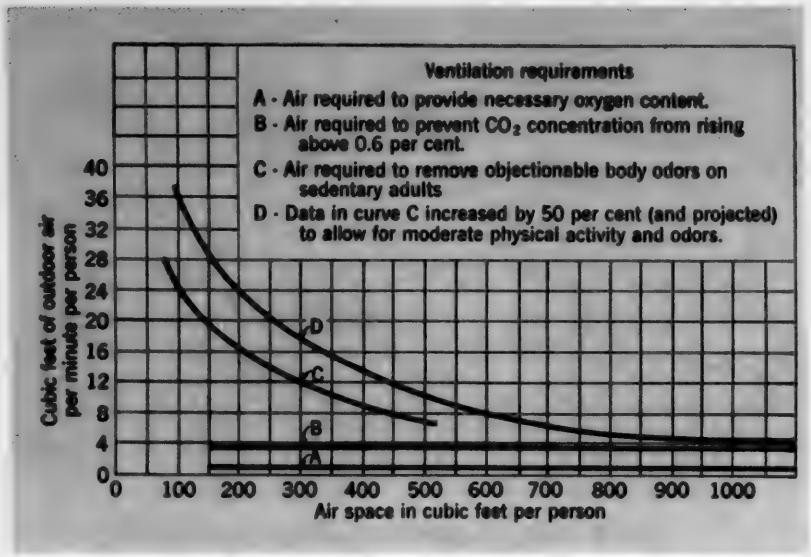


Fig. 5. Ventilation requirements for various conditions.

Ventilation is effective in removing the contaminated air in an enclosed space by logarithmic dilution. In this process, the vitiated air containing objectionable gaseous odors, irritants, particulates that obscure vision and toxic matter are replaced by clean fresh outside air. It has been shown that ventilation requirements for human occupancy is a function of the space per person and the activity. Data from several sources have been presented in a readily usable form in Fig. 5. The data of Activity Curve *D* of the figure has been found to apply reasonably well to densely populated heavy smoke-laden atmospheres as at sports arenas where vision and irritation are more of a problem than odor. It has been determined that 30 cfm per person provided effective commercial ventilation for such arenas, to avoid objectionable eye irritation, odors and impaired visibility.

The actual oxygen requirement per person varies with activity. It is normally about 0.89 cu ft per man hour when walking at the rate of 1 mile per hour. About 0.74 cu ft of carbon dioxide is liberated per man hour for normal activity. Normal air contains about 0.03% carbon dioxide. Figure 6 shows the effect of carbon dioxide on lung action. A concentration of 0.6% has little effect on lung action, increasing it only about 10% above normal.

As is shown in Fig. 5, the oxygen and carbon dioxide requirements can be met with a fresh air ventilation rate less than 4 cfm per person. A fresh air ventilation rate above 4 cfm is required to dilute odors, irritants, smoke density, (visibility), or other non-toxic conditions. The amount of ventilation required per person to remove odors or to dilute them to an acceptable value, Class 2, can be determined directly from the Activity Curve *D* of Fig. 5 for the space occupancy. The utilization of this curve is very effective for limited fresh air ventilation, such as exists in block houses, control centers and protective shelters.

Smoke and other solid and liquid particulates can be effectively removed by electronic precipitators or absolute filters. A filter of the desired performance is a requisite for most all ventilation systems. Odors, gases and vapors can effectively be removed by charcoal adsorbers or by counteraction. In cases where the room is conditioned during summer and winter, considerable fuel and power saving can usually result by use of these methods, rather than by high ventilation rates.

Charcoal Adsorption

Charcoal adsorption is defined as the physical condensation of the sorbate, gas or vapor, on the sorbent, charcoal.

The relative adsorption qualities of high quality 50 minute unimpregnated coconut shell charcoal for some vapors are given by Barnebey.

Activated charcoal has high adsorbent capacity for body odors, tobacco smoke and most odor-causing substances. One pound of charcoal takes up about 20 to 50% of its own weight. Activated charcoal cannot be satisfactorily used to remove carbon monoxide or carbon dioxide.

If analytical determination or knowledge of specific odor causing compounds and their amounts are not available, other means can be employed to determine the charcoal requirements. These may be an inventory of individual odor sources, type of occupancy and volume to be purified, or dilution of purified air, using the curves of Fig. 5 or other means. For typical occupancies, one pound of 50 minute activated coconut shell charcoal will purify for one year 2000 cu ft in residences and barracks buildings; 800 cu ft in auditoriums, offices, or restaurants; 300 cu ft in hospitals, conference rooms or schools; and 100 cu ft of air raid shelters or animal rooms. If 40-in. charcoal is to be used, then the amount of charcoal required would be 20% greater.

Activated charcoal adsorption may also remove other gases present that are toxic or otherwise objectionable but might not have an odor. The physical removal of odors by activated charcoal is limited to air temperatures not over 125 deg.

Since the usual objectionable odors are combustible and can be destroyed by burning, combustion processes are employed for odor destruction in higher temperature gases. Where it is desired to remove odors from industrial exhausts at temperatures above 125 deg, the gases can be caused to flow over a catalyst at about 500 deg and can be destroyed by catalytic combustion. For higher temperature gases, direct combustion at temperatures of 1200 deg and above are employed to destroy odors by passing through a furnace to the exhaust stack.

Activated charcoal is available in cylindrical canisters, flat plate or accordion pleated frames. They can be reactivated at a temperature of about 1000 deg in some cases. The adsorbers are provided with a fan system for recirculation or are placed in the return air stream of an air conditioning system. If a percentage of the return air is purified, the fresh air requirement, as indicated in Fig. 5, could be reduced accordingly, without affecting the odor

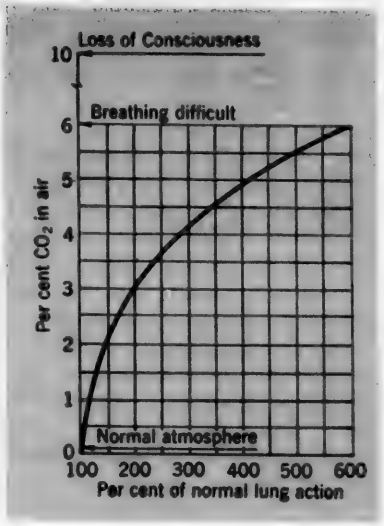


Fig. 6. Effect of per cent CO_2 in atmosphere on lung action.

level and with a saving in fresh air heating, cooling and blower costs. Four cubic feet of fresh air would still be required to supply oxygen and to prevent the carbon dioxide concentration from exceeding 0.6%.

Ventilation vs. Adsorption Economics

For a given building, the quantity of outside ventilation air supplied should be in accord with acceptable engineering standards, regulations and codes. If the installation is to be operated summer and winter, hours of operation and outdoor and indoor design conditions must be known if the air is to be cooled or heated. The Chicago Code not only specifies the total circulated ventilation air for various occupancies, but also stipulates that ⅓ of the code requirements shall be taken from out-of-doors where the space air temperature and dust content are controlled. It also stipulates that when effective adsorption devices are employed, not less than 15% of the code requirement shall be taken from the out-of-doors. This is very useful information to the designer in setting up an adequate ventilation system with or without the use of charcoal adsorbers.

For installations of a special nature where air conditions cannot be economically improved by outside air ventilation or air recovery using activated charcoal, masking or counteraction may prove desirable. The manufacturer's representatives should be consulted for those applications, and the chemical constituents of the atmosphere determined. For applications at temperatures above 125 deg, specialists on catalytic combustion should be consulted. Above 500 deg, problems existing due to obnoxious flue gases may be solved by combustion, since most odorous gases are combustible.

CONTROLS FOR COMBINED HEATING AND EVAPORATIVE COOLING SYSTEMS

S. F. DUNCAN

Director of Research, Farr Company

Application of controls is based on the controllable effects desired, and the components of the system that is considered.

ANY system combining heating and cooling has a certain number of elements common to both systems, the number depending on the design of the system. Applying controls to such a combination requires a careful consideration of the number of controllable elements in the physical system and an equally careful determination of the number of controllable effects produced by the system. The controllable elements of the physical system are such things as motors, dampers, and valves. Controls may be on-off types or modulating types such that motors may operate at more than one speed, and valves and dampers may be opened or closed any desired amount. The effects controlled by adjusting the physical elements include temperature and temperature differences, humidity, air flow rates, and time. Obviously there are relations between the controllable elements and the controllable effects since different systems have different element combinations.

Components

Evaporative cooling requires a blower; a compatible heating system would also use a blower. Both heating and cooling would then require a duct system. Economical design suggests then that the elements common to heating and cooling systems would be the blower and its drive motor and the duct and grille system. Control of the combined system and particularly the blower and air distribution system, requires a determination of the characteristics of the heating system and an understanding of the potentialities of the evaporative cooling system.

Considering the ducts and grilles only, general recommendations for air velocities for comfort heating allow about 450 to 650 fpm in the ducts. Other duct velocity recommendations suggest velocities up to 1600 fpm. Operating ratios of 2 to 1 can be tolerated as far as duct velocities are concerned. This available variation is an assistance in warm weather since people generally appreciate and feel better in air with some noticeable movement.

Two Systems Available

Two practical evaporative cooling systems are available and in use. The first is straight evaporative cooling by passing outdoor air over wetted surfaces or through spray chambers and delivering the cooled air to the occupied space. The second system adds a dry surface precooling coil ahead of the evaporative cooler, the coil being supplied with water from a cooling tower or other source. Some examples of design temperatures and the possible results obtainable from the two systems are clearly shown in Fig. 1.

The circles with their adjacent letters locate the recommended summer design conditions for cooling. The lines labelled ET F° are lines of con-

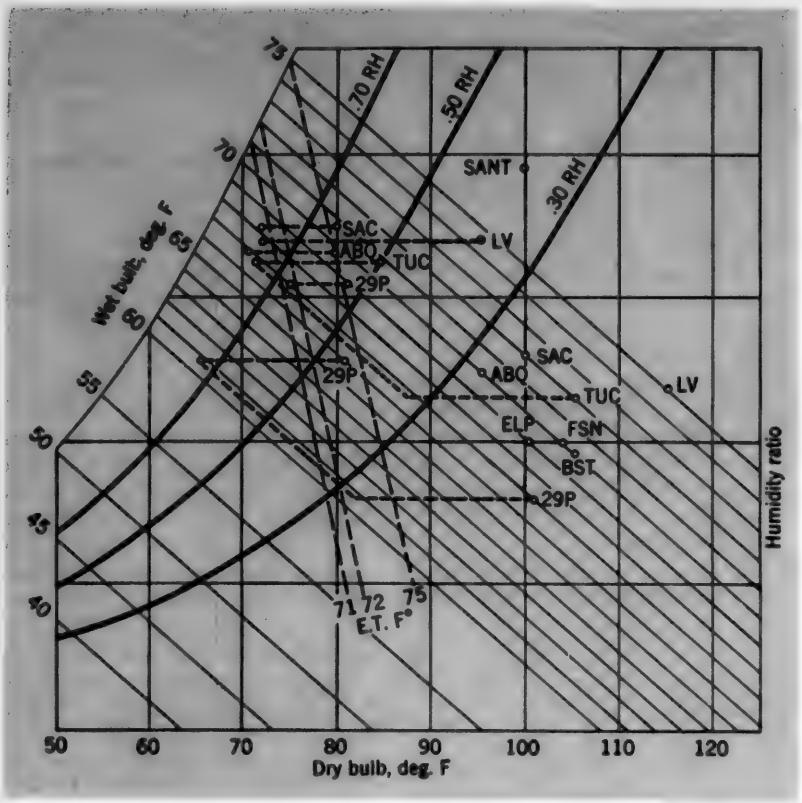


Fig. 1. Results obtainable from two types of evaporative cooling systems.

TUC—Tucson, Ariz.
BST—Barstow, Calif.
FSN—Fresno, Calif.
29P—29 Palms, Calif.
ABQ—Albuquerque, N. M.
LV—Las Vegas, Nev.
ELP—El Paso, Tex.
SAC—Sacramento, Calif.
SANT—San Antonio, Tex.

stant effective temperature for comfort conditions.

Tracing the 67 deg wet bulb line from 29P to the short horizontal line marked 29P is a typical straight evaporative cooling path. Air off the cooler is at about 75 deg DB and 67 deg WB. The available temperature rise for heat absorption is from 75 to 81 deg, the final temperature being set at 20 deg below outdoor dry bulb. If this system is combined with heating, the control on the cooling equipment should be a simple on-off switch. The use of humidistats on this simple system is not considered desirable since the humidistat shuts the cooler off during the worst weather.

The dotted paths from 29P at the right to 29P at 81 deg DB and 66 deg WB and from *TUC* on the right to *TUC* at 85 deg DB and about 71 deg WB show the conditions obtained by using evaporative cooling with pre-cooling coils. The *SAC*, *LV*, and *ABQ* lines are similarly obtained by two-stage systems, the lettered end of the line being room temperature. Considering the two-stage systems it is apparent that the opportunity for using controls is greater than in the simple system. Since it is not the function at this time to discuss the determination of required air quantities, blower sizes and duct sizes, Fig. 1 only serves to illustrate the possible results obtainable at a number of typical locations. As an example of an impossible situation, the summer design point *(SANT)* is shown near the top of the figure. An evaporative cooling path does not provide effective comfort conditions from such a starting point.

For comfort cooling, the controls on a simple evaporative cooling system combined with a heating system should perform all or more of the following functions:

1. Select "Heating," "Off," or "Cooling."
2. Select blower speed.
3. Select duct system if a two duct system is used.
4. Control inside temperature while on heating.

While on "Cooling," the blower would be on high speed and both ducts, if existing, would be carrying air. As previously stated, a humidistat to cut off the system at a predetermined high humidity is not desirable.

If the cooling system is a two-stage evaporative system, then a single duct system should be designed to handle both heating and cooling air. If there is too great a disparity between air quantities for heating and cooling, a damper can be used. The physical elements of this system that may be subject to control are:

1. Cooling, heating, and off as master switch.
2. Pre-cooling coil circulating pump, on or off.
3. Evaporative cooler, on or off.
4. Mixing or modulating dampers if desired.
5. Heating system, cycle or modulate.

The controlled results can be: Temperature, heating or cooling; temperature difference indoors to outdoors on cooling; duration of conditions not on present control point.

The combination of physical elements and controllable results allows for a wide variety of control systems, not all of them sound.

Application

A practical system now operating in a chapel at George A.F.B. near Barstow, Calif., combines a steam coil for heating with a two-stage evaporative cooling system. A single

duct system is used but the blower motor is two-speed, the low speed being half of full speed. The control system uses a "Heat" "Off" "Cooling" master selector switch. On heating, the blower runs at half speed and a modulating valve in the steam line is responsive to a thermostat. An overriding duct discharge thermostat prevents discharge of air at lower than 60 deg. On "Cooling," the blower runs at full speed. A two-stage thermostat first starts the evaporative cooler only. At a pre-set higher temperature, the thermostat starts the circulating pump on the cooling tower pre-cooling coil circuit to get maximum cooling. No attempt is made to control humidity.

If the weather permits and a close control of inside temperature is desired, bypass dampers can be installed on the evaporative cooler of a two-stage system. For instance, such a system might be desirable if outdoor conditions were such as marked at *ELP* in Fig. 1. A two-stage path starting at *ELP* would deliver air at 68 deg dry bulb. As such weather cooled off, some modulation of the duct air temperature might be desirable.

For a fancy control system using some means of modulation, it might be desirable to override the system using a differential thermostat to prevent the inside-outside temperature differential from exceeding the recommended 20 deg maximum. Conditions such as shown at *LV* in Fig. 1 might lend themselves to this extra control but the author does not know of an actual installation.

Keep Controls Simple

It is recommended that, though complicated and costly control systems can be devised, the controls be kept as simple as possible. It is also recommended that the use of humidistats on such systems seldom prove beneficial and so are a needless expense. Though humidistats are not too useful on evaporative cooling for comfort, they may be a necessity on industrial applications where the humidification (evaporative cooling) units are used in cold weather.

TESTING EVAPORATIVE COOLERS

RONALD ZABLODIL
Naval Civil Engineering Laboratory

Testing facilities were established to enable the purchaser to note if cooler operations meets specifications. Method of testing is covered.*

THE first test program for evaporative coolers was established at the Army's test center near Yuma, Arizona. Valuable information regarding pad material, scaling and bleed-off rates were obtained, but it was not too successful in obtaining basic cooler performance data—sorely needed for the various types of direct coolers. The reason was that Mother Nature didn't cooperate in providing like psychrometric conditions for all coolers. Obviously, the next step was to construct a test facility which would produce desert-like air at steady conditions. This was done, and about 2 years ago we finally got down to do some serious testing with our sights set on an equitable set of cooler purchase specifications based on test results of cooler performance.

Test Facility

The evaporative cooler test facility was built at NCEL. Its maximum capability is 9000 cfm at 130 DB and 90 WB; however, in the test program we stayed below this maximum. Outside air enters the inlet plenum and passes through an air washer where moisture is added if desired. Then through eliminator pads which removes any water carryover and past steam jets where final amounts of moisture may be injected as required. Finally, the air is heated to the desired temperature as it passes through automatically throttled steam coils. The fan's speed can be controlled to any desired cfm delivery rate up to the 900 maximum. The conditioned air moves along an insulated 25-inch diameter duct and is discharged into the cooler test plenum. The cooler test plenum is the simulated desert environment in which is placed the cooler to be tested. Various cooler static pressures may be simulated by delivering an equal amount of cfm or less than the cfm at which the cooler is rated. About as low as we dare go and still maintain good control is 500 cfm. The control panel contains all necessary instrumentation for the test facility.

Test Coolers

So much for the test facility. Now to the test coolers. The prime purpose of the tests was to determine actual performance of evaporative coolers under varied psychrometic conditions so that an equitable set of purchase specifications could be prepared. We tested a total of six coolers; a 2000, 3000, and 5000 cfm drip; a 2000 and 4000 cfm rotary, and a 3000 cfm slinger. Each was tested at dry bulb temperatures of 90 and 110 deg and wet bulb temperatures of 70, 74 and 78 deg at each dry-bulb. In addition to these temperatures, each cooler was operated at three air delivery rates for each wet and dry bulb condition. One was at the cooler's free air delivery rate and two below to simulate losses normally attendant with grilles and duct work. These simulated losses were created by operating the test facility fan at a lower air delivery rate than the test cooler fan, thus obtaining a slight vacuum on the cooler inlet side. The number of tests given each cooler totaled nine, and the length of each test was at least 48 hours in duration without shut down.

Test Data

Here is the data obtained from 300 cfm slinger. Best operation was at 110 DB and 70 WB with a delivery of 1900 cfm resulting in an effectiveness of 68%. Performance could be improved by breaking the stinger

* This two-part paper covers both the subject of testing and rating. The part on rating by John Watts, University of Texas is from his forthcoming book on Evaporative Air Conditioning, and is not used.

particles into a finer spray and wetting more of the pad area.

For a 4000 cfm rotary cooler, effectiveness ranged from 87% to 93%. Best performance was obtained at 110 DB and 70 WB when delivering 3000 cfm.

Data obtained from a 5000 cfm drip cooler showed this cooler operated evenly with an effectiveness variation from 78 to 81%. Best performance for this cooler was at 110 DB and 70 WB and delivering 3500 cfm.

The rated cfm of coolers is generally based on the fan manufacturers' rating; maximum delivery rates of the coolers are somewhat less due to the resistance of the pads.

Perhaps of considerable concern to contracting officers is whether or not the cooler is meeting specifications; is it deliverying correct cfm at a given saturation effectiveness? There is a test method whereby this can be done without an elaborate facility such as NCEL's. The method is simple, requires a minimum of test apparatus and instrumentation, and is accurate because it ties directly to air psychrometry. It is as positive as the fact that water runs down hill.

By use of the psycrometric chart and tables it is possible to compute the amount of water the cooler should evaporate per minute and how much the evaporator should lower the dry bulb temperature. While computations indicate what the cooler should do, the final step is to actually test it. This can be done by a sling psychrometer, a scale, a small sump pump, about a 25 gal capacity container, and a few feet of pipe or tube. The cooler is placed outside in the shade. (It is assumed for the purpose of this example that the air is 100 DB and 70 WB.) The 25 gal container is placed on the scale, about three-quarters filled with water.

The cooler is started and is allowed to operate until temperatures have stabilized; about 30 minutes should be long enough. Stop the cooler and quickly weigh the tank of water. Start the cooler and make at least a 30-minute run. During the run, hold the sling psychrometer in the cooler's air stream—the dry bulb should read 76 deg. At the end of the 30 minutes stop the cooler and again weigh the tank of water. The difference in the weight is amount of water evaporated by the cooler and should be

$$1.35 \times 30 = 40.5 \text{ pounds}$$

Tables could be prepared or curves drawn showing evaporation rates versus saturation effectiveness for various combinations of wet and dry bulb temperatures thus eliminating the need for computations. The foregoing is based on atmospheric pressure at sea level; 29.92 Hg. Variations due to higher altitudes would not significantly alter computed results.

As an added thought, the cooler outlet temperature, T_2, may be also computed by the heat balance method:

$$0.24\ (100 - T_2) = 1037\ (.0055)$$
$$= 76 \text{ deg}$$

Where 0.24 is the specific heat of air at constant pressure and 1037 is the heat of vaporization of water at 100 deg.

Notes on Refrigerant Piping

The first problem involved in the design and installation of a field erected direct expansion system is the suction line which has probably caused more trouble than all other portions of the system combined, according to J. R. Chamberlain, Manager, Product and Application Engineering Dept., York Division of Borg-Warner Corp., speaking before a symposium of ASHRAE. What follows is abstracted from his paper.

The size of the suction line depends upon two distinct and opposing considerations.

(1) It is necessary to limit the suction line size to minimize first cost and to assure sufficiently high gas velocity to return oil at all load conditions;

(2) The suction line size must be kept sufficiently large to minimize pressure drop which, if excessive, reduces the system capacity and increases the electrical energy required per unit of cooling.

With these opposing influences, compromises must be made, sometimes with disastrous results. To generously size the suction line to minimize the pressure drop, the operation of the system becomes jeopardized due to insufficient gas velocities which retard the flow of oil from the evaporator to the compressor, with the oil accumulating in low portions of the horizontal lines.

Another hazard is the accumulation of oil at some point in a suction line in sufficiently large quantities that the oil can return to the compressor in the form of a slug when the compressor capacity is increased. When the system is inoperative, any oil lying in the suction line, unless held at low pressure, will absorb refrigerant and further increase the liquid quantity. Upon startup of the compressor, the high gas velocity will sweep the liquid into the compressor suction. A refrigeration compressor is designed to handle refrigerant vapors and not large quantities of liquids. Liquid pumping by reciprocating compressors can result in broken valves, pistons, connecting rods and even wreckage of the housing.

The discharge line, although not so critical as the suction line, also requires a careful analysis in the system design. Again, the choice must be made in favor of operating economy (small pressure drop), trouble free operation, or a compromise of these influences.

The suction and discharge lines must also be designed with consideration given to the off cycle when no mechanical cooling is required. Long vapor lines in a colder ambient temperature than the compressor equipment room, frequently encountered when evaporative condensers are mounted outside, will result in refrigerant condensation in the colder areas. The liquid formed can flow back to the compressor, causing dilution of the crankcase oil. This crankcase dilution can cause the compressor oil pump to lose its prime when placed in operation, resulting in poor compressor lubrication.

When evaporative condensers and receivers are idle on a roof in the sun and the compressor is in a cooler basement or similar location, migration of liquid to the colder area may fill up a discharge line to the compressor and, should discharge valves leak, even fill up the compressor. It is no wonder compressor crack-ups occur under these circumstances.

CALCULATING FLOW IN SEWERS

Figures 1 and 2 are used to calculate the velocity and depth of flow in closed, circular conduits that do not flow full. The data are those recommended by Clay Sewer Pipe Association, Inc., Columbus, Ohio.

Example. Given 520 ft of conduit with a loss of 2.70 ft in elevation and an estimated maximum future daily flow of 4.27 million gallons per day. Sewer to be designed to flow about half full.

Solution. One million gallons per day equals 1.55 cubic feet per second. Therefore, for pipe flowing one-half full, flow is 4.27 × 1.55 = 6.6 cfs. Doubling for full-pipe flow, 2 × 6.6 = 13.2 cfs, or 2 × 4.27 = 8.54 million gal per day.

Slope is the length of conduit divided by loss in elevation, or 520/2.70 = 0.0052 ft per ft.

Enter Fig. 2 at a slope of 0.0052 and discharge of 8.54 million gallons per day and note that next largest available pipe is 24 inches dia. Using the Manning formula, find velocity, V:

$$V = (1.486/n)\, R^{2/3}\, S^{1/2}$$

$$V = (1.486/.013)\ (2/4)^{2/3}\ (0.0052)^{1/2}$$

where $n = 0.013$ is the recommended friction coefficient for clay pipe; R = hydraulic radius = one fourth pipe diameter; and S = slope.

$$V = (114.3)\ (0.63)\ (0.0721) = 5.2 \text{ fps.}$$

Full-pipe flow is the product of velocity and pipe area:

$$Q = AV = (3.14)\ (1)^2\ (5.2) = 16 \text{ cfs.}$$

Ratio of estimated flow, 6.6 cfs to full-pipe flow, 16 cfs, is 0.415. Entering Fig. 1 at bottom, *Ratio of Hydraulic Elements* = 41%, and proceeding to *Discharge* curve, read *Per cent of Flow* = 45%. Then, going to the right on the 45% line, intersect *Velocity* curve at 95% *Ratio of Hydraulic Elements.*

Actual velocity will be per cent velocity times full-pipe velocity, or 0.95 × 5.2 = 4.94 fps. Depth of flow will be per cent of flow times pipe diameter, or 0.45 × 24 = 10.8 inches.

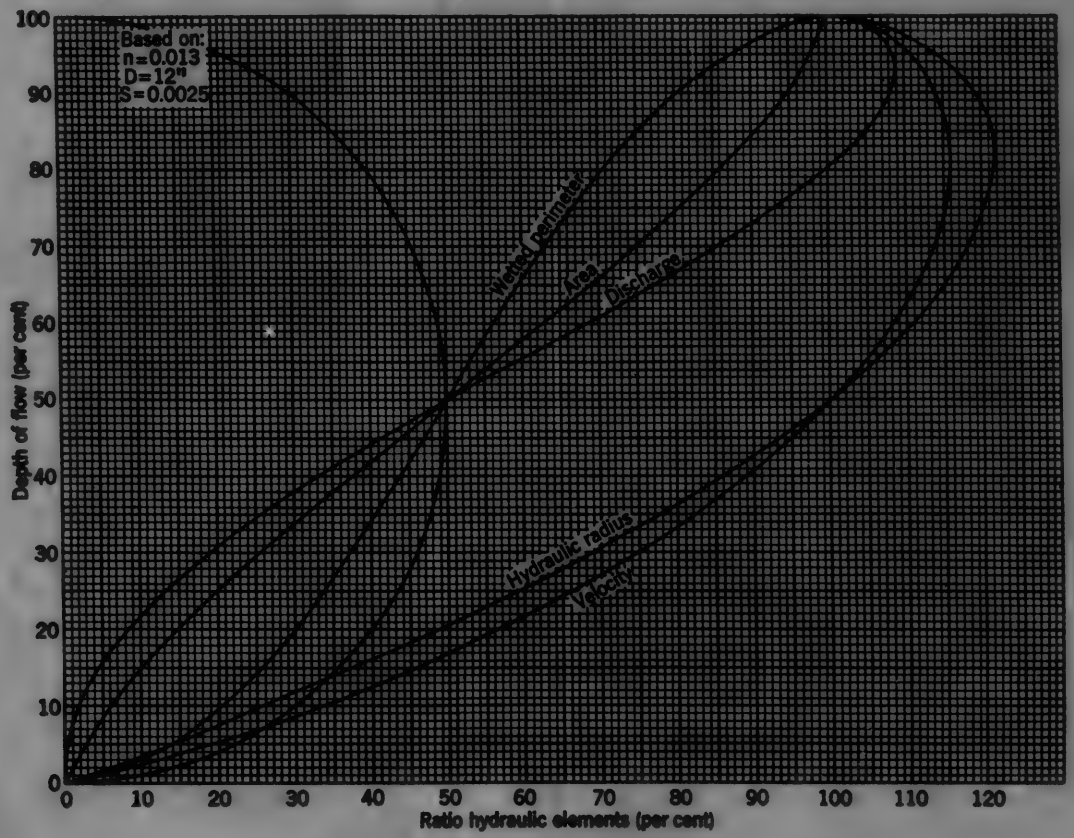


Fig. 1. Enter at bottom to get factors for velocity and depth of flow.

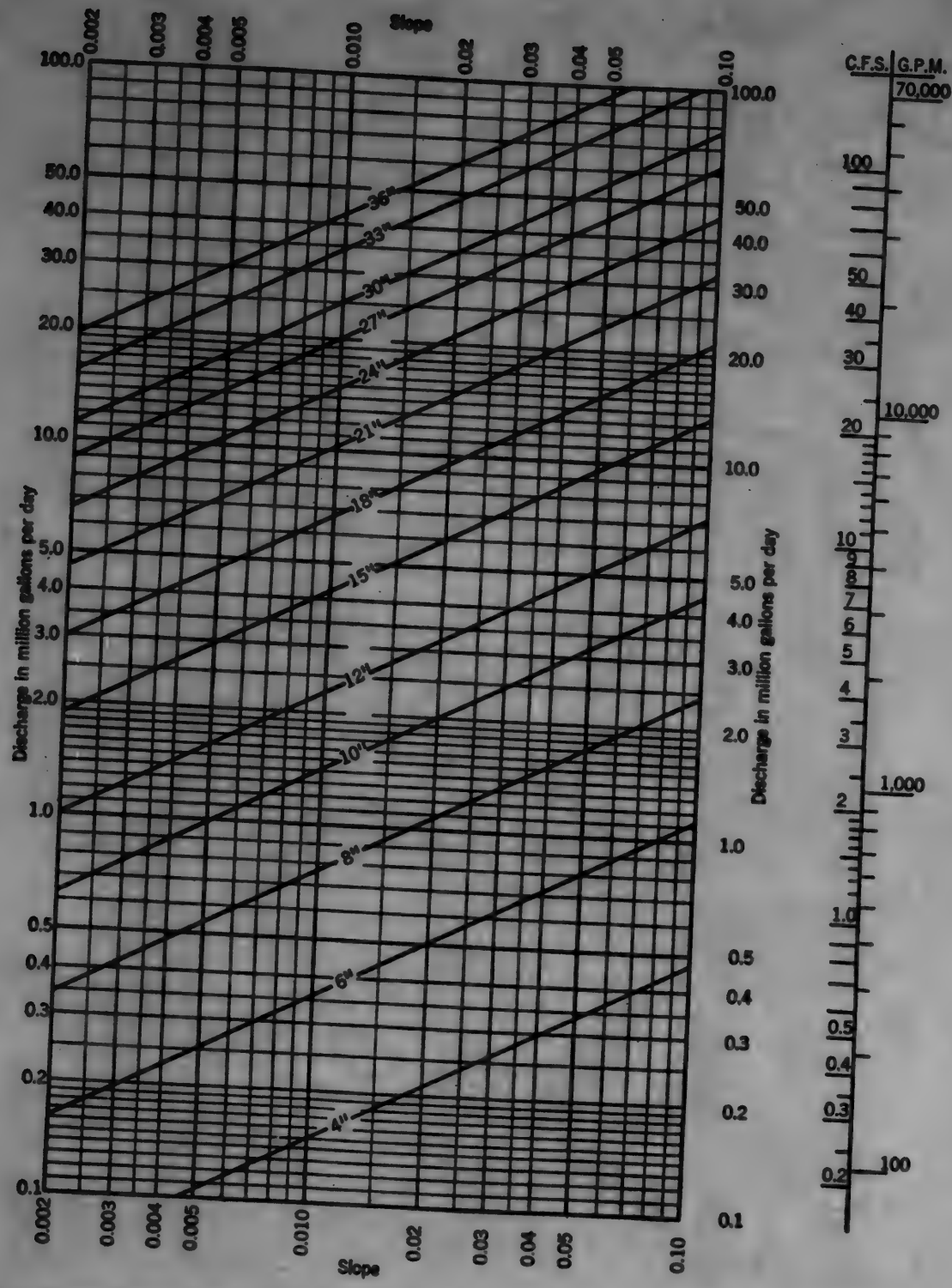
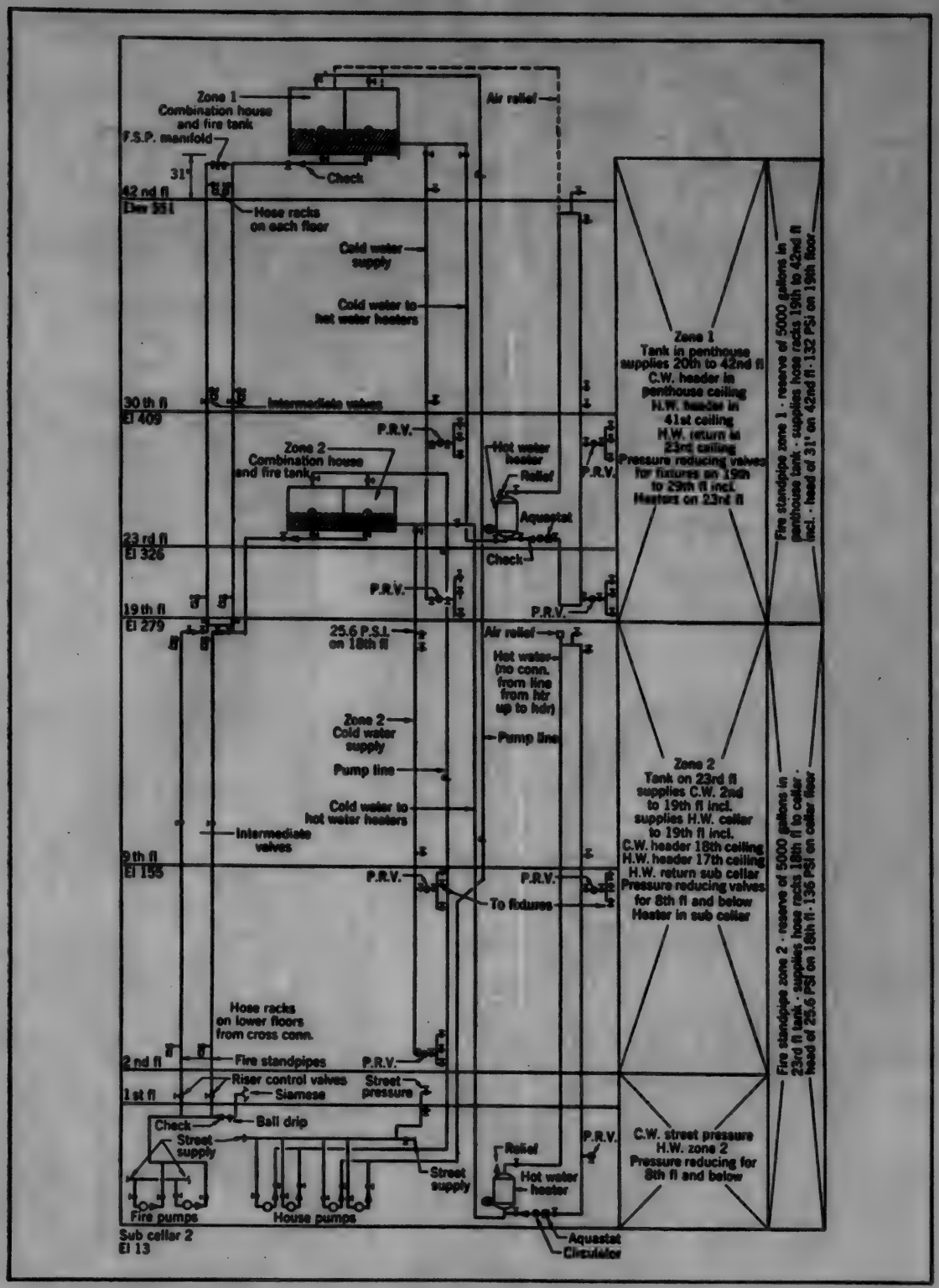


Fig. 2. Discharge of circular pipes running full, based on Manning formula, $Q = A\ (1.486/n)\ R^{2/3}\ S^{1/2}$, where $n = 0.013$. Use this chart to select pipe size.

GRAVITY WATER SYSTEM FOR TALL BUILDINGS

Water Supply System With Pressure Reducing Valves



DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

September, 1959

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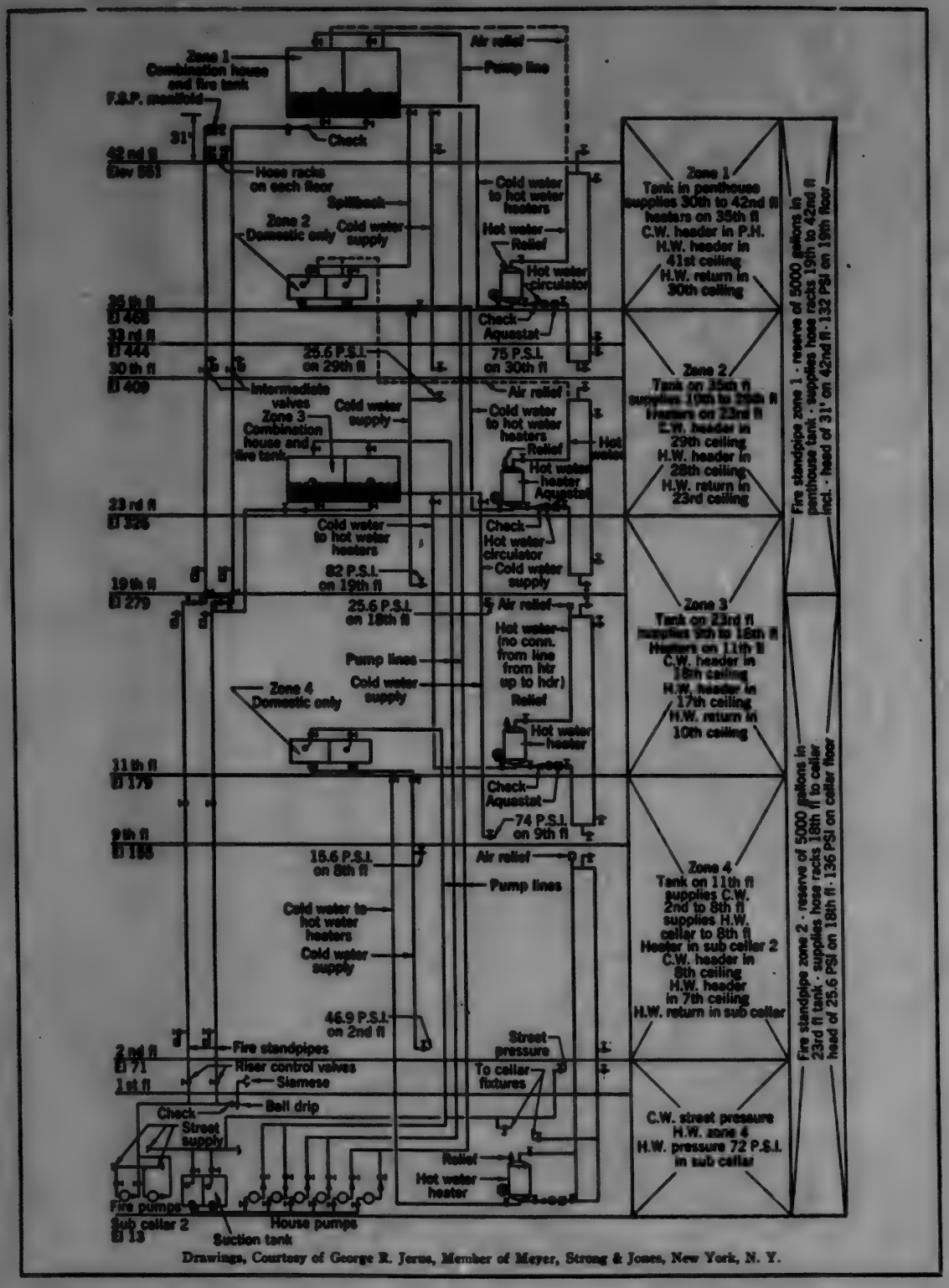

Drawings, Courtesy of George R. Jerus, Member of Meyer, Strong & Jones, New York, N. Y.

DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

September, 1959

One Engineering Solution for

Temperature and Humidity Control When Computers Are Added

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Medium Transformer Dept., General Electric Co., Rome, Ga.

When the addition of computer equipment to an office building compounded the heat gain and confounded the existing air conditioning system, engineers did a custom-designed job to hold temperature and humidity within prescribed limits. Here is a factual report of that job.

THE use of electronic data processing equipment is rapidly spreading to most large industrial plants. In the summer of 1957, General Electric made the decision to install a computer in the Medium Transformer Plant at Rome, Georgia. Although the main office building is air conditioned, like most office air conditioning systems it was not adequate to handle cooling load or humidity requirements placed on the system by computer equipment. The heat liberated by the electronic units required cooling and air handling beyond the capacity of the building system. Also, the system would not maintain humidity limits required for the use of moisture sensitive plastic tapes in computer application.

The computer is housed in a room on the first floor of the two-story office building. The building is of the girderless slab, reinforced concrete type construction. Three metal partition walls separate the computer room from the rest of the building. The fourth wall of the room is the outside wall of the building. The ceiling height, an important dimension, is eleven feet.

A special condition was placed on the air conditioning for the computer room. The equipment was to occupy no floor space because a shortage of floor space existed in the office building.

Fig. 1. Hood-like ducts, connected directly to electronic units at right, increase capacity of cooling unit.

The limits for temperature, humidity and dust content of the air are specified by the computer manufacturer. The limits are: Temperature to be between 60 and 80 deg F, humidity to be between 40 and 60% r.h., and dust content per 1000 cu ft of air to be one gram maximum for particles of one micron or larger.

Since the fresh air supply has an effect on temperature and humidity, the fresh air supply was the first consideration. Ventilation air for the building is supplied by a central unit air conditioner and distributed by a duct system. The air is filtered and either heated in the winter or cooled and dehumidified in the summer. A dewpoint thermostat which modulates bypass dampers provides summer humidity control of ventilation air supplied by the building system. To take advantage of the present equipment and reduce new equipment required, fresh air for the computer room was taken from the building ventilation air supply. In the summer some cooling is done by fresh air because the air is furnished at the room dewpoint temperature.

Temperature Control

The cooling load is the largest load to be considered. The following table shows the heat gained by the room. No heat is gained through ceiling or partition walls because the adjoining office temperature is within prescribed limits.

Source	Heat gain, Btu per hr
Computer units	203,000
Occupants	4,000
Windows	6,270
Outside wall	780
Lights	20,500
Total	235,000

Three G. E. Model FCW-75, 7½-ton, ceiling-mounted packaged unit air conditioners were chosen to cool the room. The ceiling mounted units satisfied the condition that no floor space be occupied by the cooling equipment. Water cooled condenser type units were chosen because the plant has a central spray-cooled pond with pumps and pipe distribution system. The 7½-ton unit was the largest ceiling-mounted unit available and was chosen to keep the number of units required to a minimum.

Study of the layout showed the advisability of installing ductwork from the top of the computer and power supply unit to the intake of one cooling unit. Three advantages are gained by a duct arrangement: First, the heat is transferred almost directly to the cooling medium

instead of heating up the room atmosphere; second, the capacity of the cooling unit is increased due to an increased temperature difference between air entering evaporator and refrigerant in evaporator; and third, latent heat or vapor removal capacity is reduced, which decreases the load on humidification equipment.

Model FCW-75 has an air flow of 3000 cfm., The power supply unit for the computer unit has an air flow of 1000 cfm, and the computer has an air flow of 2000 cfm. The following table shows that one conditioner is adequate in cooling capacity to absorb all the heat liberated by the power supply and computer; therefore the two electronic units were connected to one air conditioner by hood-like ducts, as shown in Fig. 1. Thermostat for the conditioner is located in the duct, which insures that the conditioner will run when the computer is in operation.

Item	Cfm	Btu per hr
Power unit	1,000	29,600
Computer	2,000	56,100
Total	3,000	85,700
FCW-75	3,000	95,800

A remote unit air conditioner, part of the building air conditioning system, is located under the windows of the room. The unit consists of a coil, fans, and control. The coil receives chilled water in summer and hot water in winter. The two remaining FCW-75 units are controlled by thermostats mounted on the wall. The total cooling capacity installed in the room is 253,000 Btu per hr, allowing a safety factor of 18,000 Btu per hr for installation of future computer equipment.

Heating for the room is furnished by the remote unit. For additional heating a hot water coil was installed in the air distributor of one of the cooling units. The control consists of a solonoid valve and thermostat.

Humidity Control

The condition that no floor space be occupied by air conditioning equipment also applied to humidity control equipment. The dehumidification load is small due to two facts: First, the fresh air supplied to the room has been cooled and dehumidified by the building system; and second, the air conditioning units remove a large quantity of moisture from the air when they are cooling. However, experience had shown that the building system did not hold the humidity below 60% r.h., so some load is caused by ventilation air.

The facilities available and special requirements made the design of a humidity control unit a necessity. The unit consists of an electrical refrigeration type dehumidifier made by modifying a ceiling-mounted air cooled packaged unit air conditioner, and an electric heated pan type humidifier. The equipment is controlled by a double-acting hair element humidistat located on the wall.

Figure 2 shows the air conditioner before modification, and Fig. 3 shows the complete humidifier-dehumidifier unit. The air conditioner used was a G. E. Model FCA-30.

The modification consisted of changing the air flow by making the following revisions: Add new cabinet section on condenser end of unit; move condenser fan to new cabinet; close off passage over condenser coil; cut opening in panel dividing evaporator section from condenser section; close side and top openings for air entering evaporator; remove evaporator fan; enlarge

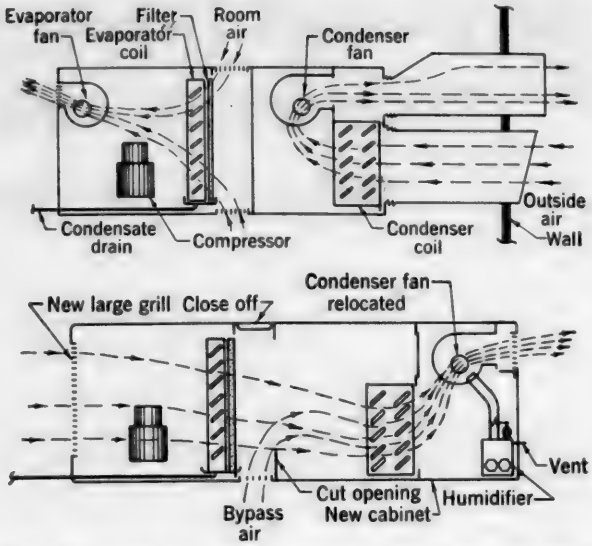


Fig. 2. (top) Packaged conditioner before modification.
Fig. 3. (bottom) Unit as modified for humidity control.

opening and install grill in front of unit; and, install humidifier in new cabinet section.

The operation on dehumidification is as follows: Air enters unit and passes through evaporator coil where it is cooled and dehumidified. Air then passes through condenser coil where it is reheated, and fan blows air back into the room. Fan is shut off when the unit is not operating to prevent moisture on the coil from being evaporated. Air will leave the unit at a higher temperature than it enters due to heat absorbed from condensate. This heat is not figured in cooling load because the dehumidifier will not operate when the cooling load is maximum. The FCA-30 unit has a latent capacity of 15,500 Btu per hr which will condense 14.7 lb water per hr. This dehumidification capacity is 6.7 lb per hr more than the 8 lb per hr that was calculated to be the load (ventilation air, 5 lb per hr; occupants, 3 lb per hr).

The humidifier consists of a tank with float-type level control and electric heaters. The moisture is admitted through a pipe on top of the tank. The pipe has a butterfly valve to prevent moisture from condensing on fan motor. When the humidistat stops calling for moisture the heaters are shut off, but a time delay relay causes the fan to run for three minutes before stopping. After the fan stops, the butterfly valve closes to prevent steam escaping from tank into fan cabinet. Two 4000 watt immersion heaters, installed in the tank, will evaporate 23 lb water per hr. Since the calculated load is 22.1 lb per hr, sufficient humidification capacity is provided.

Dust control is not believed to be a problem because the air is filtered so many times in passing through the room. The ventilation air is filtered by the building system and is filtered again each time it passes through an air conditioning unit or a computer unit. The air is filtered between 30 and 50 times in passing through the room; the number of times depends on the number of units in operation.

The system installed here is not intended to be an improvement on a good central system. It is, however, a good inexpensive system that could be used by anyone facing the conditions and problems that existed in Rome.

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Robot Water Sample Analyst Aids Treatment Firm

A robot analyst which can do almost everything a technician does in making chemical analyses—only faster—has been enlisted by Water Service Laboratories, Inc., New York, N. Y., in the fight against corrosion. The firm of research and consulting chemical engineers, specializing in the field of water treatment, each week does some 5000 analyses of water samples taken from air conditioning installations, domestic water systems and boilers. The water samples are analyzed to insure that the proper kind and amount of water treating chemicals are being fed at each installation.

Previously, samples were manually analyzed, a process involving a series of individual operations that had to be repeated for every sample. Sample measurement and preparation, dilution, and reagent addition were accurately duplicated for each analysis. Many of the chemical reactions required a time delay to insure completion. Comparison and recording were done manually.

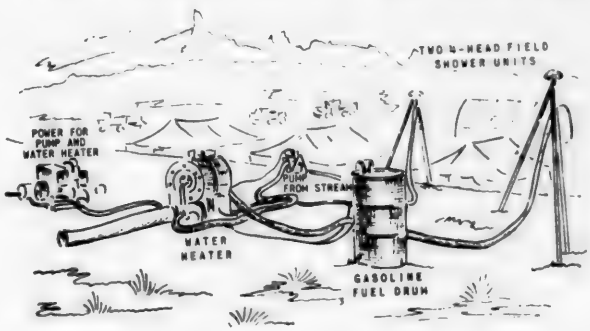
As shown in photo, the new instrument, known as the Autoanalyzer, is a photo-electric colorimeter equipped with automatic devices which provide continuous sam-

pling, addition of chemical reagents, separation of impurities, mixing, measuring of color and recording of results. It is manufactured by Technicon Controls, Inc., Chauncey, N. Y.

According to Irving Portnoy, laboratory supervisor, the Autoanalyzer, once properly calibrated for each analytical method, can carry out as many as sixty analyses per hour. The technician's auxiliary tasks in connection with the operation of the instrument, which include pouring samples, transcribing results and cleaning the equipment, require a limited amount of time, leaving him free to carry out more complex analyses, or analyses which are done in such limited number that it would not be suitable to adapt them to the Autoanalyzer.

Army Field Facilities Enhanced By Portable Shower Units

An order for 213 portable 8-man field shower bath units has been received by Orr & Sembower, Inc., Reading, Pa., from the Army's Quartermaster Purchasing Agency, Columbus (Ohio) General Depot. The equipment consists of a self-contained gasoline-fired water heater to supply approximately 2 gpm of warm bath water to each of the eight showerheads. Water for the unit is



drawn from the source of supply through a suction hose by means of a pump which forces it through the water heater. The heated water then continues through the discharge hoses to dual shower stands.

Electricity is furnished to the water pumps and water heaters by an engine generator, although this component is not a part of the Orr & Sembower contract.

The shower water heater is a self-contained unit consisting of a gasoline-fired burner, specially designed gas-to-water heat exchanger shell, fuel pump, blower supplying combustion air, and safety and operating controls. Gasoline fuel will be taken directly from 55-gal shipping drums.

Warm Air Will Thaw Coal To Facilitate Unloading

Five gas-fired Counterflo warm air space heaters will be installed by Dravo Corporation, Pittsburgh, in a 460-ft long car shed at the new sintering plant of U. S. Steel Corporation at Saxonburg, Pa. The units thaw coal to facilitate unloading from rail cars.

Each of the five heaters will have an output capacity of 1,000,000 Btu per hr. Installed in an inverted position, the heaters will discharge heated air into a trench below the car tracks at the rate of 12,500 cfm per heater. When coal is thawed, the cars will be shunted from the shed to another building for unloading.

Medium

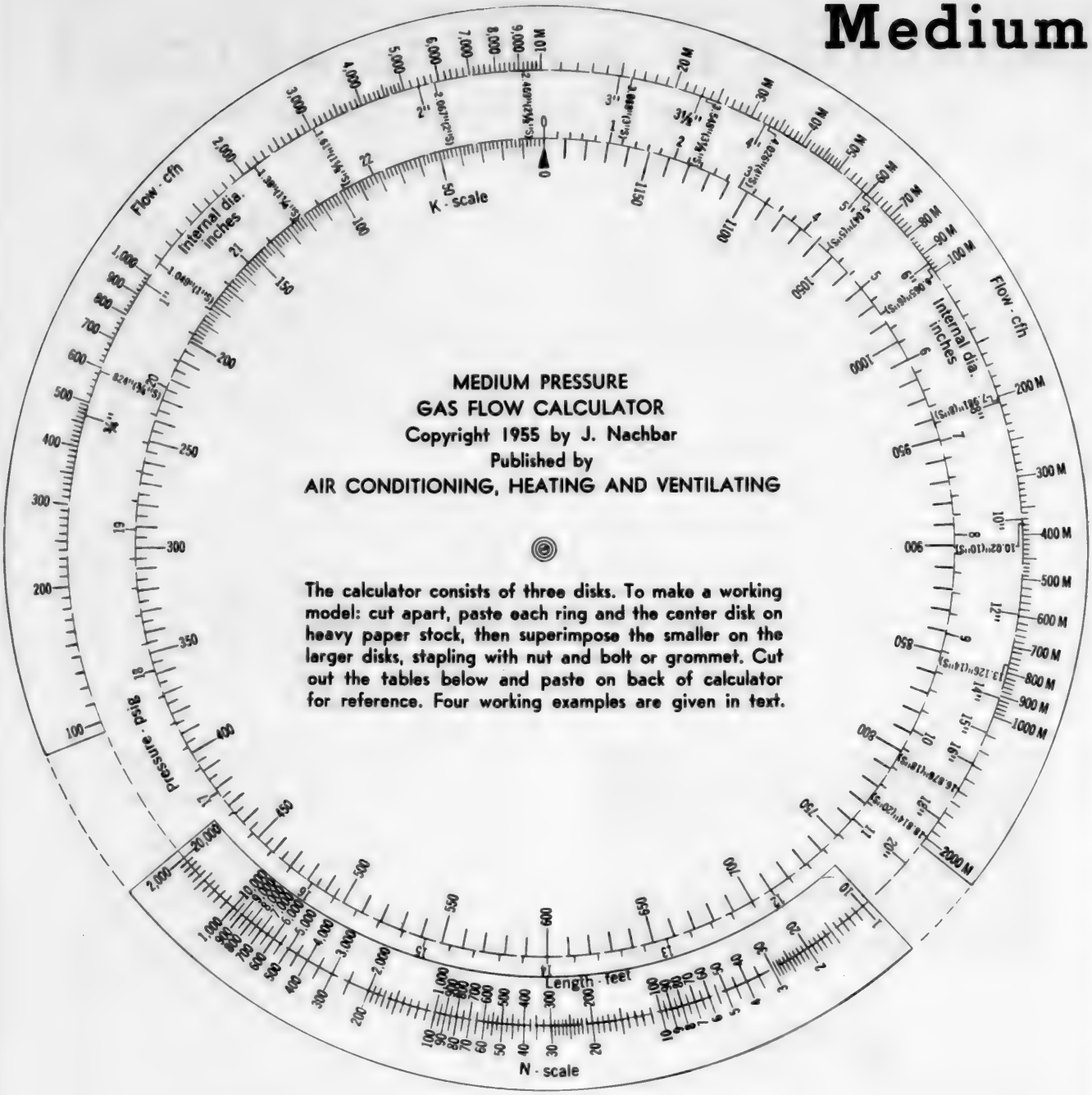

MEDIUM PRESSURE
GAS FLOW CALCULATOR
Copyright 1955 by J. Nachbar
Published by
AIR CONDITIONING, HEATING AND VENTILATING
The calculator consists of three disks. To make a working model: cut apart, paste each ring and the center disk on heavy paper stock, then superimpose the smaller on the larger disks, stapling with nut and bolt or grommet. Cut out the tables below and paste on back of calculator for reference. Four working examples are given in text.
Flow - cfh
Internal dia. inches
K - scale
Pressure - psig
Length - feet
N - scale

TABLE 1—CORRECTION FACTOR, *F*, FOR SPECIFIC GRAVITY

Specific Gravity	*F*	Specific Gravity	*F*
.35	.54	.80	1.23
.40	.62	.85	1.31
.45	.69	.90	1.39
.50	.77	1.00	1.54
.55	.85	1.10	1.69
.60	.92	1.20	1.85
.65	1.00	1.30	2.00
.70	1.08	1.40	2.15
.75	1.16	1.50	2.31

TABLE 2—ABSOLUTE PRESSURE AT DIFFERENT ALTITUDES

Altitude Ft above Sea Level	Absolute Pressure, Psia Add to Gage Pressure:
0	14.7
500	14.4
1,000	14.2
1,500	13.9
2,000	13.7
3,000	13.2
4,000	12.7
5,000	12.2
6,000	11.8

Pressure Gas Flow Calculator

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PRACTICALLY every industrial plant or laboratory requires a gas system for either heating or process purposes. The Medium Pressure Gas Flow Calculator was developed to fill the need for fast and accurate sizing of gas piping in architectural engineering and plant engineering offices.

For safety reasons, the gas pressure in industrial plants is generally limited to a maximum of 20 psi. The range selected for this calculator, therefore, is 1-22 psi.

The scales are developed for gas of specific gravity of .65 (air = 1.00) with multiplying factors for gases of higher or lesser specific gravity. The slide rule is based on gas flow at altitudes of 500 ft above sea level. For all practical purposes, however, the calculator will give sufficiently accurate readings at altitudes up to 1,500 ft above sea level, or higher, depending on the required accuracy.

Use of the calculator in the range of pressures above 22 psi and for altitudes higher than 1,500 ft above sea level is described in the working examples below.

All scales are based on the Weymouth formula for pipes 3 inches in diameter and larger, and on the Cox formula for pipes under 3 inches in diameter.

The Weymouth formula is:

$$Q = 18.062\ (T_o/P_o)\ [(P_1^2 - P_2^2)\ (d^{16/5})/GTL]^{1/2}$$

The Cox formula is:

$$Q = 33.3\ [(P_1^2 - P_2^2)\ (d^5)/GL]^{1/2}$$

where

Q = Rate of flow in cubic feet per hour at temperature T_o and pressure P_o,
d = Internal diameter of pipe, inches,
L = Length of pipe, miles,
G = Specific gravity of gas, here taken as 0.65,
T_o = Absolute temperature, degrees Fahrenheit, to which Q is reduced, here taken as 519.6,
T = Absolute temperature, degrees Fahrenheit, of the flowing gas, here taken as 519.6 (60 deg above 0 deg F),
P_o = Absolute pressure to which Q is reduced, here taken as 14.73 psi,
P_1 = Initial absolute pressure, here taken as gage pressure plus 14.4 psi,
P_2 = Terminal absolute pressure, here taken as gage pressure plus 14.4 psi.

To use the calculator, express flow rate in cubic feet per hour, pressure in pounds per square inch gage, pipe diameter in inches, and length in feet.

Example 1.

Given: Flow, 60,000 cfh of gas whose specific gravity is 0.65; initial pressure, 6 psi; pipe diameter, 6 inches; pipe length, 1,000 ft.

Find: Terminal pressure.

Solution: (1) Set arrow indicator on *K* scale opposite initial pressure of 6 psi. (2) Set flow of 60,000 cfh opposite pipe diameter of 6 inches. (3) Read the number *40* on *N* scale opposite pipe length of 1,000 ft. (4) Opposite the number *40* on the *K* scale will be found the terminal pressure of 5 psi.

Example 2.

Given: Flow, 150,000 cfh of gas whose specific gravity is 0.65; initial pressure, 15 psi; terminal pressure, 10 psi; length of pipe, 5,000 ft.

Find: Required pipe diameter.

Solution: (1) Set arrow indicator on *K* scale opposite initial pressure of 15 psi. (2) Read the number *269* on *K* scale opposite terminal pressure of 10 psi. (3) Set length of 5,000 ft opposite the number *269* on *N* scale. (4) Opposite flow of 150,000 cfh will be found the required diameter of 8 inches.

For gases of specific gravity different from 0.65, multiply length of pipe by *F*, a factor from Table 1. The product of pipe length and *F* is used to set calculator.

Example 3.

Given: Specific gravity of gas, 0.90; initial pressure, 11 psi; terminal pressure, 10 psi; pipe diameter, 6 inches; pipe length, 1330 ft.

Find: Pipe capacity.

Solution: (1) Set arrow indicator on *K* scale opposite initial pressure of 11 psi. (2) Read the number *50* on *K* scale opposite terminal pressure of 10 psi. (3) From Table 1, for specific gravity of 0.90, read $F = 1.39$ and multiply length of pipe, 1330 ft, by 1.39 to get 1850 equivalent feet of length. (4) Set equivalent length of 1850 opposite the number *50* on the *N* scale. (5) Opposite pipe diameter of 6 inches will be found the capacity of 49,000 cfh.

For pressures above the range of this calculator, 22 psi, and for altitudes greater than 1,500 ft above sea level, disregard the *K* scale, and operate the calculator as follows:

Example 4.

Given: Flow, 700,000 cfh; altitude, 4,000 ft; initial pressure, 100 psig = (100 psig + 12.7) psia = 112.7 psia (see Table 2); terminal pressure, 95 psig = (95 + 12.7) psia = 107.7 psia; length, 3000 ft.

Find: Required pipe diameter.

Solution: (1) Square the absolute initial pressure ($112.7^2 = 12{,}701$). (2) Square the absolute terminal pressure ($107.7^2 = 11{,}599$). (3) Find the difference of the squares (12,701 — 11,599 = 1102). (4) Use the difference, 1102, as the *N* number, and set it opposite the length of 3,000 ft. (5) Opposite the flow of 700,000 cfh will be found the required pipe diameter of 10 inches.

In the June, 1959 Reference Section, hereinafter referred to as Part 1, the author presented his time-saving procedure for piping stress analysis. In Part 2, he extends his procedure to systems with bends of different radii of curvature and to systems with anchor movements. He digresses briefly to compare his procedure with the rigorous method, to show that, for all practical purposes, the results using his procedure are almost the same.

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Time-Saving Procedure for Piping Stress Analysis – Part 2

PIPING SYSTEM WITH BENDS OF DIFFERENT RADII OF CURVATURE

The simplicity and efficiency of the procedure presented in Part 1 are seen in the combined table, Table 9, which presents a complete solution for the problem in Grinnell Company's *Piping Design and Engineering*, pages 62 through 67. For an analyst experienced in using this procedure, the calculations in Table 9, or the calculations for any two-anchor, three-dimensional system, require about two and one-half hours.

It is important to note that the example worked out in Table 9 is different from the examples presented in Part 1 of this article, in that the analysis in Table 9 is of a piping system containing bends with different radii or curvature, and that calculations of centroidal line inertias for elbows, that is, for I_o values (See Equations 25, Part 1) are included. Line data, final numerical results, and their comparison with the results in *Piping Design and Engineering* were presented in Table 4 of Part 1. The same line data are included in Table 9. (Table 4 is here reproduced for the reader's convenience.)

Since calculations in Table 9 are based on E_h, the modulus of elasticity at the hot condition, instead of E_c, the modulus of elasticity at the cold condition, as was done in the Grinnell book, the numerical results are those for the piping system in the hot condition.

Further, since, in the Grinnell book, $\alpha = 1.15\ L_a$ (the formula for transverse virtual length, before the 1955 Code was published) instead of $\alpha = 0.5\ (K + 1)\ L_a$, as in Part 1, we have for elbows *bc* and *fg* in Table 9:

$$R = 4.16$$
$$L_a = \pi R/2 = 6.53$$
$$\alpha = 1.15\ (6.53) = 7.51$$
$$\beta = KL_a - \alpha = 2.39\ (6.53) - 7.51 = 8.10$$

and for elbow *de:*

$$\alpha = 1.15\ (1.96) = 2.26$$
$$\beta = 7.01\ (1.96) - 2.26 = 11.50$$

Table 9 can be simplified and made more efficient by multiplying the above β values by 3.333, that is,

$$\beta = 3.333\ (8.10) = 27.00 \text{ (for } bc \text{ and } fg)$$
$$\beta = 3.333\ (11.50) = 38.33 \text{ (for } de)$$

and, for the entire system, by multiplying the Basic Sum, row (15), Table 9, by the same factor:

Basic Sum = (15) =

$$[(1) + (3) + (5) + (14) + (10a)] \times 3.333$$

If these factors are used, rows (2), (4) and (6) can be eliminated from Table 9, thus saving more time and labor in the calculations. In this case, 3.333×0.149 and 3.333×0.137 must be used for the constants in Equations 25 for centroidal line inertias of elbows and bends:

$$I_{ox} = I_{oy} = I_{oz} = 0.497\ R^3\ [Km + (K + 1)\ n] = 0.497\ R^3\ [KN + n] \quad (25a\text{-}1)$$

$$I_{oxy} = I_{oxz} = I_{oyz} = 0.457\ KR^3\ \Sigma \pm \text{ signs.} \quad (25b\text{-}1)$$

Also, I_1, I_2, and I_3 in Equations 7g, 7h, and 7i of Part 1 should be divided by 3.6 instead of by 12.

TABLE 9

	DESIGNATION	X	Y	Z	L^3	L	Lx	Lx^2	Ly	Ly^2	Lz	Lz^2	Lxy	Lxz	Lyz
BRANCH // Z	ef	0	0	-2.58	1996	12.59	0	0	0	0	-32.9	716	0	0	0
	(1) SUM			I_1									0		
	(2) (1)×0.3					3.78	0	0	0	0					
BRANCH // Y	ab	14	12.08	0	3974	15.84	221.8	3105	191.3	2311	0	0	2679	0	0
	gh	0	6.08	-18	56.6	3.84	0	0	23.3	141.7	-69.1	1244	0	0	-419
	(3) SUM			I_2 4031		19.68	221.8	3105	214.6	2453	-69.1	1244	2679	0	-419
	(4) (3)×0.3					5.90	66.54	931.5			-20.73	373.2		0	
BRANCH // X	cd	5.55	0	0	634	8.59	47.7	265	0	0	0	0	0	0	0
	(5) SUM			I_3											0
	(6) (5)×0.3					2.58			0	0	0	0			
ELBOWS // XY	bc				L=1		12.49	156	1.51	2.3	0	0	18.9	0	0
					No. ells										
	(7) SUM					8.10	101.17	1263.6	12.23	18.63			153.09		
	(8) (7)×β		β = 8.10												
ELBOWS // XZ	dc				L=1		0.45	0.20	0	0	-0.45	0.20	0	-0.20	0
	e														
	(9) SUM				No. ells										
	(10) (9)×β		β = 11.50			11.50	5.18	2.30	0	0	-5.18	2.30	0	-2.30	0
	(10a) (9)×α		α = 2.26			2.26	1.02	0.45			-1.02	0.45		-0.45	
ELBOWS // YZ	fg				L=1		0	0	1.51	2.3	-16.48	272	0	0	-24.88
	(11) SUM				No. ells										
	(12) (11)×β		β = 8.10			8.10			12.23	18.63	-133.49	2203.2			-201.53
	(13) (7)+(11)					2	12.49	156	2.02	4.6	-16.48	272	18.9	0	-24.88
	(14) (13)×α		α = 7.51			15.02	93.80	1171.56	22.68	34.55	-123.76	2042.72	141.94	0	-186.85
TOTAL LINE INERTIAS	(15) (1)+(3)+(5)+(14)+(10a)					58.14	364.32	4542.01	237.28	2487.53	-288.78	4003.17	2820.94	-0.45	-405.85
													2976.03		
XY	(16) Σ·(2)+(8)+(12)					70.02	465.49	5805.61	249.51	2506.18					
	(17) (16)÷ΣL						$\bar{x}$ = 6.65		$\bar{y}$ = 3.56						
	(18) (17)×Σ						$\bar{x}\Sigma L_x$ = 3095.51		$\bar{y}\Sigma L_y$ = 888.26				$\bar{y}\Sigma L_x$ -1657.14		
	(19) (16)-(18)						I'_y = 2710.10		I'_x = 1617.92				I'_{xy} = 1316.89		
XZ	(20) Σ·(4)+(8)+(12)					75.54	436.04	5475.81			-314.69	4378.67		-2.75	
	(21) (20)÷ΣL						$\bar{x}$ = 5.77				$\bar{z}$ = -4.17				
	(22) (21)×Σ						$\bar{x}\Sigma L_x$ = 2515.95				$\bar{z}\Sigma L_z$ = 1312.26		$\bar{z}\Sigma L_x$ = -1818.27		
	(23) (20)-(22)						I'_z = 2959.86				I''_z = 9066.41		I_{xz} = 1815.54		
YZ	(24) Σ·(6)+(12)+(15)					68.82			249.51	2506.18	-422.27	6206.37			-807.38
	(25) (24)÷ΣL								$\bar{y}$ = 3.62		$\bar{z}$ = -6.14				
	(26) (25)×Σ								$\bar{y}\Sigma L_y$ = 905.72		$\bar{z}\Sigma L_z$ = 2592.74			$\bar{z}\Sigma L_y$ = -1531.99	
	(27) (24)-(26)								I''_x = 1600.46		I_y = 3612.63			I'_{yz} = 724.61	

LINE DATA

10" Sch. 40
A-106, Gr. A

D	10.75	Δy	0.7296
t	0.365	Δz	1.0944
I	160.8	R	4.16, 4.25
S	29.9	K	2.39, 2.01
T	750°F	L_a	6.83, 1.98
c	6.00%	i	1.03, 2.52
E_h	24.82 (in)	α	7.51, 2.26
E_c	—	β	8.10, 11.50
Δ_x	0.8512		

CENT. LINE INERTIAS

$I_{ox} = I_{oz} = 0.149\left[2(2.39+2.30)4.16^3 + 7.01(1.25^3)\right] = 52.35$

$I_{oy} = 0.149\left[2(2.39)4.16^3 + 2.30(1.25^3)\right] = 51.94$

$I_{oxy} = 0.137(2.39)4.16^3 = 23.57$

$I_{oyz} = -23.57$

$I_{oxz} = 0.137(7.01)1.25^3 = 1.88$

COEFFICIENTS (FROM TOTAL LINE INERTIAS)

(a) $-\frac{I_{xy}}{I_x} = -\frac{13190}{5238} = -0.255$ Ⓐ $\quad -\frac{I_{xz}}{I_x} = -\frac{1817}{5238} = -0.346$ Ⓑ $\quad \frac{\Delta_x E_h I}{1728 I_x} = \frac{.8512(24.82)(160.8)}{1728(5238)} = .374$ Ⓒ

(b) $\frac{I_y}{I_{xy}} = \frac{6595}{1340} = 4.925$ $\quad -\frac{I_{yz}}{I_{xy}} = -\frac{701}{1340} = 0.523$ $\quad \frac{\Delta_y E_h I}{1728 I_{xy}} = \frac{.7296(24.82)(160.8)}{1728(1340)} = 1258$

(c) $-\frac{I_{yz}}{I_{xz}} = -\frac{701}{1817} = 0.385$ $\quad \frac{I_z}{I_{xz}} = \frac{5001}{1817} = 2.759$ $\quad \frac{\Delta_z E_h I}{1728 I_{xz}} = \frac{1.0944(24.82)(160.8)}{1728(1817)} = 1389$

I'_x = 1618	I'_y = 2710	I'_z = 2960
I''_x = 3066	I''_y = 3614	I''_z = 1600
$I_{y/2}$ = 166	$I_{1/2}$ = 166	$I_{2/2}$ = 336
$I_{1/2}$ = 336	$I_{3/2}$ = 53	$I_{3/2}$ = 53
I_{ox} = 52	I_{oy} = 52	I_{oz} = 52
I_x = 5238	I_y = 6595	I_z = 5001
I'_{xy} = 1316.89	I'_{xz} = 1815.54	I'_{yz} = 724.61
I_{oxy} = 23.57	I_{oxz} = 1.88	I_{oyz} = -23.57
I_{xy} = 1340.46	I_{xz} = 1817.42	I_{yz} = 701.04

TOTAL LINE INERTIAS

FORCE RANGES (FROM COEFFICIENTS)

(1)(a)+(b)	4.670	-0.869 Ⓓ	1632
(2)(a)+(C)	-0.640	2.413 Ⓔ	1763
(3)(2)×Ⓒ/Ⓑ	0.230 Ⓕ	-0.869	-635 Ⓖ
(1)-(3)	4.440 Ⓚ		2267 Ⓛ

$\frac{Ⓓ}{Ⓔ} = \frac{-0.869}{2.413} = -0.360$, $Y = \frac{Ⓛ}{Ⓚ} = \frac{2267}{4.440} = 511$

$Z = \frac{Ⓖ - (Ⓕ)Y}{Ⓓ} = \frac{-635 - 0.23(511)}{-0.869} = 866$

$X = Ⓒ - Ⓐ Y - Ⓑ Z = 374 + 0.255(511) + 0.346(866) = 804$

$X' = \frac{X}{Z} = 0.928$ $\quad Y' = \frac{Y}{Z} = 0.590$

MOMENTS, TORQUES & STRESS (FROM Z, M_{xy}, M_{xz}, M'_{yz})

At "a", $M = 866\sqrt{10.92^2 + 12.76^2} = 14549$ ft-lb.
$T = 866(4.36) = 3776$ ft-lb.

At "h", $M = 866\sqrt{8.04^2 + 11.38^2} = 12055$ ft-lb.
$T = 866(7.06) = 6114$

At "e", max. ax. stress $S_e = S_a = \frac{12(866)2.52}{29.9}\sqrt{8.98^2 + 6.51^2} = 9372$ (M'_{yz} negligible)

RELATIVE MOMENT AND TORQUE (FROM X', Y')	POINT	a	e	h
	x	14	0	0
	y	20	0	8
	z	0	-1.25	-18
$\bar{x}$=6.65	x-$\bar{x}$	7.35	-6.65	-6.65
$\bar{y}$=3.56	y-$\bar{y}$	16.44	-3.56	4.44
(1)	X'(y-$\bar{y}$)	16.26	-3.30	4.12
(2)	Y'(x-$\bar{x}$)	4.34	-3.92	-3.92
	M'_{xy}	10.92	0.62	8.04
$\bar{z}$=-4.17	z-$\bar{z}$	4.17	2.92	-13.83
3)	X'(z-$\bar{z}$)	3.87	2.71	-12.83
$\bar{x}$=5.77	x-$\bar{x}$	8.23	-5.77	-5.77
	M'_{xz}	-4.36	8.48	-7.06
$\bar{z}$=-6.14	z-$\bar{z}$	6.14	4.89	-11.86
5)	Y'(z-$\bar{z}$)	3.62	2.89	-7.00
$\bar{y}$=3.62	y-$\bar{y}$	16.38	-3.62	4.38
	M'_{yz}	-12.76	6.51	-11.38

DISCUSSION OF ACCURACY

While Table 4 indicates nearly complete identity between the numerical results of the present procedure and Grinnell's procedure (Spielvogel's Method), Table 5-C of Example 5, Part 1, indicated that the numerical results of the present method were almost identical with the electronically computed results by the rigorous Kellogg Method. Table 2 of Example 2 showed that the deviations of the present results from that of the electronically computed Kellogg's results range from -2% to $+7\%$. Applying this procedure to a three-dimensional system, computed electronically by Edwin A. Wert with Kellogg's Method, yields the following ratios of the final numerical results to Mr. Wert's results: 1.07, 0.95, 1.0, 1.0, 0.98, 1.0, 1.04, 0.97, 1.0, 1.01, 1.01.

Greater deviations would occur in piping systems with special characteristics, ie., compact three-dimensional systems containing flexible (large-diameter and thin-wall) elbows and short tangents, the elbows thus constituting a significant portion of the system. Application of this procedure to a large number of published numerical examples indicates that the maximum deviation of final results of this procedure from the published electronically computed results of the rigorous Kellogg Method is approximately 10%. It should be remembered that piping flexibility calculations, however precisely made from a mathematical standpoint, will always remain approximate due to the many assumptions involved.

The above discussion concerns only three-dimensional systems. When applied to single-plane systems, the present procedure yields final results almost identical with those of the rigorous Kellogg Method. As an example, analyzing the single-plane system on page 124 of *Design of Piping Systems* (by M. W. Kellogg Company) yields two ratios of 1.01 and nine ratios of 1.00.

The smallest force, Z (183 lb) in Table 5-C of Example 5, Part 1, is insignificant, so its difference from the electronically computed result is not important. The torque in Table 2 of Example 2 ($T = M_{zz} = 948$ ft lb), being much smaller than moments in magnitude, does not affect the accuracies of the resultant moment and controlling stress range. Hence, its ratio is not shown. In general, the accuracies of the smallest force and torque do not affect the resulting design of the piping system, so they are of no great importance.

PIPING SYSTEMS WITH ANCHOR MOVEMENTS

In Part 1, the procedure for analysis was applied to piping systems *without* anchor movements. Since anchor movements, due to expansion or movement of vessels, often exceeds the piping expansion several times, the forces, moments and stresses due to anchor movements may be many times those due to piping expansion.

Example VII

The piping system illustrated in Table 10A is a symmetrical single plane system, anchored at *a* and guided at *g*. In analysis, the system is considered to be also anchored at *g*, which point moves toward *a* due to the expansion of 150 ft of piping between *g* and *h*.

Since the straight branch *gh* of the system does not contribute any flexibility, the flexibility of the system is symmetrical about the center line between *a* and *g*, placing the centroid of the system on the center line. Thus, it is necessary only to

(1) Locate the origin of the centroidal axes on the Y-axis, *i.e.*, find $\bar{y}$;

(2) Substitute $I_y = I_{xy} = 0$ in

$$X - Y\,(I_{xy}/I_x) = (\Delta_x\, E_c\, I/1728\, I_x) \quad (27)$$

$$-X + Y\,(I_y/I_{xy}) = (\Delta_y\, E_c\, I/1728\, I_{xy}) \quad (28)$$

TABLE 4*—COMPARISON OF RESULTS

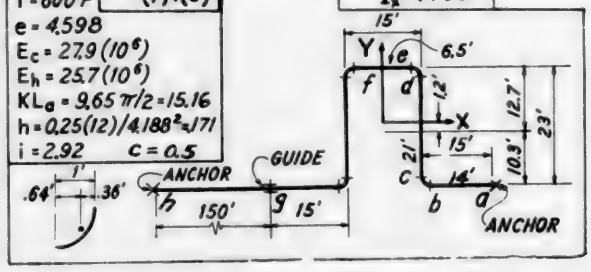
		Author's Procedure	Grinnell Procedure	Ratio
Forces	X	804	811	0.99
	Y	511	514	0.99
	Z	866	874	0.99
At *a*	Moment	14,549	14,700	0.99
	Torque	3,776	3,820	0.99
At *h*	Moment	12,055	12,160	0.99
	Torque	6,114	6,170	0.99
At *e*	S_b	9,372	9,460	0.99

* This table appeared originally in Part 1 of this article. Original table number retained.

TABLE 10A—DATA FOR EXAMPLE VII

	DESIGNATION	L^3	L	Ly	Ly^2	y
ELL ‖ XY	*b c*		L = 1	-11.14	124	
	d e			11.14	124	
(1)	SUM		NO. OF ELLS 2	0	248	
(2)	KL_a x(2)		30.3	0	3760	
BRANCH Y	*c d*	9261	21	0	0	0
BRANCH X	*o b*		14	-161	1851	-11.5
	e f		6.5	74.7	860	11.5
(3)	SUM	I_g 9261	41.5	- 86.3	2710	
LINE DATA	(4)	Σ=(2)+(3)	71.7	- 86.3	6470	
8"Sch.20 A106-Gr.B	(5)	(4)÷ΣL		$\bar{y}$ = -1.204		
I = 57.7	(6)	(5) x Σ		$\bar{y}\Sigma Ly$ = 104		
S = 13.39	(7)	(4) - (6)		I'_x = 6366		
T = 600°F	(8)			$I_{z/2}$ = 772		
e = 4.598		(7)+(8)		I_x = 7138		

$E_c = 27.9\,(10^6)$
$E_h = 25.7\,(10^6)$
$KL_a = 9.65\,\pi/2 = 15.16$
$h = 0.25(12)/4.188^2 = .171$
$i = 2.92 \quad c = 0.5$



Thus, the equations of forces (27) and (28) are reduced to one equation, *i.e.*, $X = \triangle_x E_c I/17281_x$. This equation indicates the existence of only one force.

(3) Consider point *f* as fixed with respect to rotation and translation in the X-direction (Free movement of *f* in the Y-direction is accounted for by using $\triangle_y = Y = 0$.) and, analyze only portion *af* to simplify the solution;

(4) Use half of the total expansion of the system in the analysis, *i.e.*, one half of the length of the system (195 ft) in hundreds of feet times the expansion coefficient, e = 4.598 inches per 100 ft, or $\triangle_x = (1/2)(1.95)(4.598) = 4.483$ inches.

From Table 10A, we have

$$X = \frac{\triangle_x E_c I}{1728\, I_x} = \frac{4.483(27.9)10^6(57.7)}{1728(7138)} = 585 \text{ lb.}$$

At elbow *e*,

$$M_e = 585(12.7) = 7430 \text{ ft-lb}$$

$$s_e = s_b = \frac{2.92(7430)12}{13.39} = 19443 \text{ psi} < 22500 \text{ psi } (s_a)$$

At anchor *a* or guide *g*,

$$M_a = M_g = 585(10.3) = 6026 \text{ ft-lb}$$

$$s_a = s_b = \frac{6026(12)}{13.39} = 5400 \text{ psi}$$

Applying the stress intensification factor, 1.3, for average anchor condition, the increased stress range is

$$s_e = 1.3(5400) = 7020 \text{ psi}$$

For 50% cold spring (c = 0.5), the hot and cold forces for the system are, from Equations 18,

$$X_h = (2/3)(25.7/27.9)(585) = 0.614(585) = 359 \text{ lb}$$
$$X_c = 0.5(585) = 293 \text{ lb}$$

The hot and cold moments at *e* are

$$M_h = 359(12.7) = 4562 \text{ ft-lb}$$
$$M_c = 293(12.7) = 3715 \text{ ft-lb}$$

and those at *a* and *g* are obtained similarly, or as follows:

$$M_h = 0.614(6026) = 3700 \text{ ft-lb}$$
$$M_c = 0.5(6026) = 3013 \text{ ft-lb}$$

If the cold spring is removed from the system,

$$X_h = (25.7/27.9)(585) = 0.921(585) = 539 \text{ lb}$$
$$X_c = [1 - (15{,}000/19443)(27.9/25.7)]585 = 0.1625(585) = 95 \text{ lb}$$

where $s_h = 15{,}000$ psi is taken from the Code.

The hot and cold moments at *e* are

$$M_h = 0.921(7430) = 6830 \text{ ft-lb}$$
$$M_c = 0.1625(7430) = 1207 \text{ ft-lb}$$

and those at *a* and *g* are

$$M_h = 0.921(6026) = 5550 \text{ ft-lb}$$
$$M_c = 0.1625(6026) = 980 \text{ ft-lb}$$

Thus, it is seen that by eliminating cold spring, the hot force and moments increase by 50%, while the cold values decrease considerably. The cold spring, however, does not affect the stress range values.

The above results indicate that with the cold spring, in hot condition the piping system exerts a force of 359 lb on the anchor, a moment of 3700 ft-lb on the guide or anchor and a maximum moment of 4562 ft-lb in the system. In the cold condition, the system exerts a force of 293 lb on the anchor, a moment of 3013 ft-lb on the guide or anchor, and a maximum moment of 3720 ft-lb in the system. Thus, in achieving 50% cold spring, *i.e.*, cutting the system *ah* short by 4.5 inches in the cold condition, the ends of the pipe at the joint must be brought together during installation with a force of 293 lb and a moment not more than 3720 ft-lb. The controlling stress range of 19,443 psi is below the allowable stress range (22,500 psi for power piping and 28,900 psi for refinery piping). Hence, the system is not overstressed.

The same system has also been analyzed by the Kellogg Method on the IBM 650 digital computer at the Service Bureau Corporation, Los Angeles, which has set up an efficient pipe stress program for engineering companies in that area. The comparison of the above results with the computer results is given in Table 10B, which indicates that the two sets of results are identical.

TABLE 10B — COMPARISON OF RESULTS

				Author's Procedure	Kellogg Method (by Computer)
c = 0.5	Forces	Hot	X	359	359
			Y	0	0
		Cold	X	293	292
			Y	0	0
	Moments	Hot	M_a, M_g	3,700	3,702
			M_e	4,562	4,565
		Cold	M_a, M_g	3,013	3,014
			M_e	3,715	3,718
	Moment Range		M_e	7,430	7,435
	Stress Ranges		at *a* & *g*	5,400	5,404
			at *e*	19,443	19,466
c = 0	Forces	Hot	X	539	539
			Y	0	0
		Cold	X	95	95
			Y	0	0
	Moments	Hot	M_a, M_g	5,550	5,553
			M_e	6,830	6,848
		Cold	M_a, M_g	980	985
			M_e	1,207	1,208

Notes on Part I

Referring to page 83 of the June issue, one should understand that the subscript, *i* is defined only over the summations for I_x' and I_{xy}, and are meant (though not repeated) for the terms below them.

Please ignore the minus sign that appears, in error, in front of *D* in the equation for *Z*, found at the bottom of Tables 1-A and 5-A on pages 84 and 91.

Notes that the phrase "The above elbow" that appears below Equation 10 on page 86 refers to the elbow in Fig. 6, and that $s_b = 9372$ psi, found on page 90, is at *e*.

Elbow *hk* in Fig. 3, page 88, is in XZ plane, and should turn toward the negative direction of X-axis.

In Table 5-A, page 91, in the box headed "LINE DATA," the value, $i = 1.85$ is for *f*. The value of *i* for *a* is 1.30. Also, in Fig. 6, page 93, are the three views of an elbow parallel to the XY plane.

The column headings of Table 6, page 94, may be misread. The x, y, and z symbols are not subscripts. At the top, right of Table 7, page 95, read "Table 3-A" instead of "Table 1," and on page 96, the reference is to Fig. 3, not Fig. 4.

LOUIS BLENDERMANN ON

PIPING AND PLUMBING

Parts of a Septic Tank System

LAST month's article on septic tank systems covered the general arrangement of the different systems that could be used based on the particular location and grade in which each system is installed. This article will cover in more detail, the component parts of the systems described.

Septic Tanks

The prime function of a septic tank is to condition the raw sewage so that it may be readily percolated into the ground. Thus, the septic tank affords assurance that effluent from the tank can meet the absorption ability of the soil. It provides these three features:

1. Removal of solids.
2. Biological treatment.
3. Sludge and scum storage.

Removal of Solids. The suspended solids in the raw sewage settle to the bottom of the septic tank, thereby allowing the clarified effluent to be discharged for disposal.

Biological Treatment. Solids and liquid in raw sewage are subjected to decomposition by bacterial and natural processes. Bacteria of the anerobic variety thrive in the absence of free oxygen. The treated sewage causes less clogging in the means of disposal than untreated sewage.

Sludge and Scum Storage. Sludge is the accumulation of solids at the bottom of the septic tank while scum is a partially submerged mat of floating solids. Both types of solids are digested by bacterial action but nevertheless the septic tank must be of sufficient capacity and equipped with baffles that will retain material which is not fully digested, during the interval between periodic cleanings.

There are a wide variety of septic tanks that may be used for the digestion of raw sewage and for retention of the liquid until the final discharge of the waste water to the particular means of disposal. These tanks vary from precast concrete tanks to large elaborate structures, designed and constructed to handle the specific sewage load. Furthermore, the concrete structures are built in many different shapes and forms in accordance with site conditions or express design favored by the engineer.

Fabricated steel tanks of varying sizes and shapes are available for septic tank application. Comprehensive data regarding these tanks may be requested from the respective equipment manufacturer.

Several of the different types of concrete structures are illustrated in Fig. 1.

Detail *A* shows a small capacity septic tank, constructed of concrete. This sized unit can be obtained in pre-cast form. Briefly, it consists of an inlet and outlet tee connection and an access cover. A marker at grade level indicates the exact location of the cover.

Detail *B*, a larger capacity unit, shows primary and secondary settling tanks constructed of reinforced concrete. Again, inlet and outlet tee connections are used. A cover is provided over each chamber for inspection and cleaning purposes. Markers are set in the grade to indicate the exact location of covers.

Detail *C* illustrates a still larger capacity septic tank, including primary and secondary settling chambers. The installation features an inlet connection, baffling arrangement and a dosing chamber with a siphon device. Two access covers at grade are also included. The settling chambers are sloped to allow the sludge to accumulate at the low point in the tank. This facilitates the cleaning operation. The sloping bottom is also desirable when

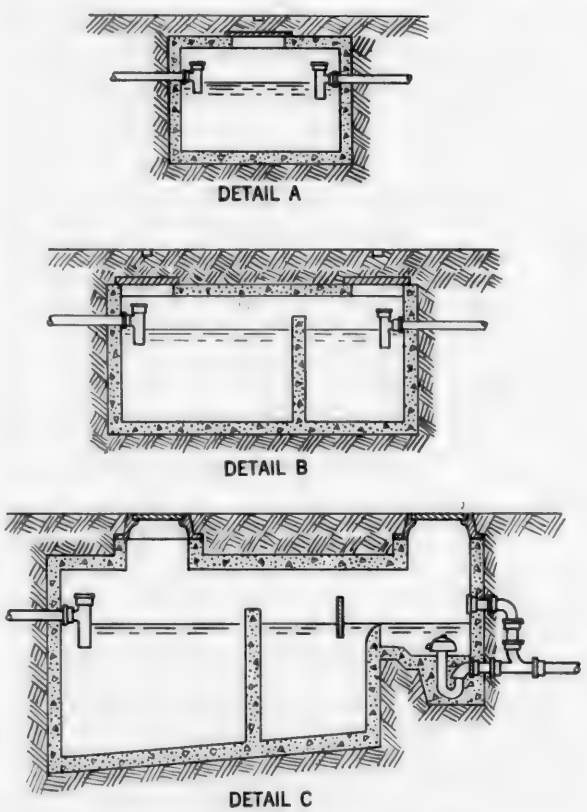


Fig. 1. Several types of septic tanks.

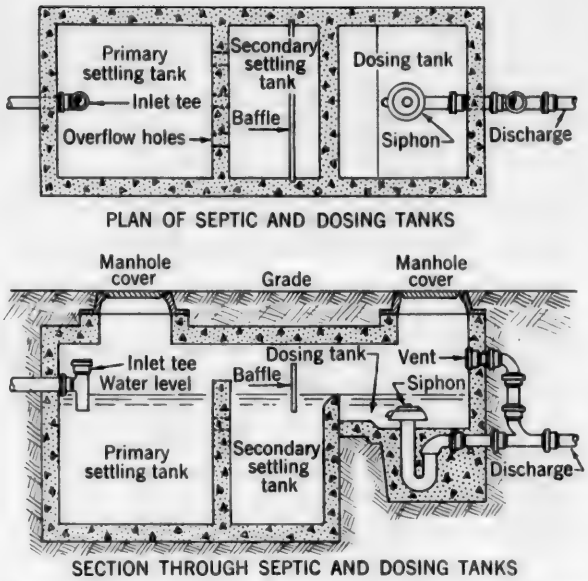


Fig. 2. Details of a combination septic and dosing tank.

a pumping arrangement is utilized with suction lines connected under the septic tank at the low point.

Concrete septic tank structures should be carefully designed and built to carry the slab across the top of the tank and, in addition, sustain a prescribed surface loading to which the structure may be subjected. With proper care and maintenance, a septic tank will provide many years of dependable service.

Typical Septic Tank

Figure 2 shows the typical septic tank that has been used for example throughout this article. This tank is a reinforced concrete structure, although the reinforcing has not been detailed. The structure consists of a primary and secondary settling tank. An outlet tee is used to baffle the flow of raw sewage into the tank. A baffle in the secondary compartment controls turbulence and retains the scum in the tank.

As the effluent passes into the dosing tank, a prescribed depth of water activates the siphon device and the quantity of waste water is discharged to the means of disposal. A vent connection is installed at the outlet to provide the atmospheric pressure needed to assure free flow of the waste water to the leaching means. Covers that extend up to the grade are provided to offer access to each of the compartments.

Although this particular design of septic tank was shown for example, many other designs and shapes of septic tanks may be used with equal success. Moreover, septic tanks constructed of other materials can also be used. It is important to point out however, that the design and construction of the septic tank system must conform to the requirements of the local plumbing or health authorities, whichever has jurisdiction.

Distribution Boxes

A distribution box is a concrete structure that is erected between the septic tank and the leaching area. Its prime function is to ensure an even distribution of the effluent to the overall leaching area. This provides for better handling of the effluent.

There are a number of different types of distribution boxes that may be utilized to satisfy a specific arrangement of drainage piping or seepage pits. Figure 3 illustrates some of the different shapes and sizes.

The distribution box is constructed to meet the needs of the specialized arrangements of piping which are connected to it. It is the proposed piping arrangements which account for the different shape of the distribution boxes.

Typical Distribution Box

Figure 4 shows the type of distribution box that has been used for example in this article. The small scale plan shows the general application of the distribution box with a septic tank and leaching area.

Referring to the plan of the distribution box, note that a baffle is used to divert the effluent to either one section of the piping in the leaching area or the other. This practice is important because it allows one section of the drainage piping to be used while the other section is draining dry. The baffle is constructed of either wood or steel, with a handle on top, if desired, for easy removal. The frequency in diverting the flow of effluent is determined by the maintenance personnel and is usually gained after the system is in operation for a period of time and its needs have become evident.

The section taken through the distribution box shows how the piping connections are placed. The line from the dosing tank is set at a higher elevation than the discharge lines to the leaching area.

The distribution box is equipped with a cover at grade for easy access. The structure itself is of concrete and

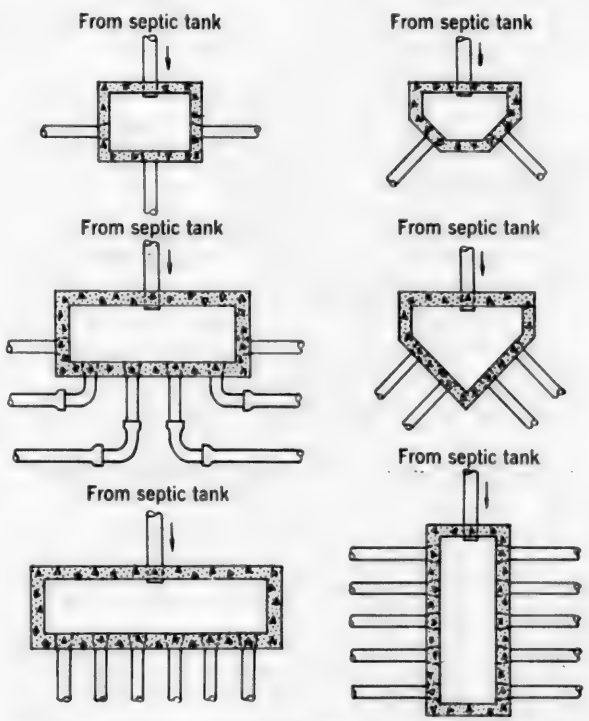


Fig. 3. Plan views of several of the many different types of distribution boxes.

when surface loads are prevalent, is constructed of reinforced concrete.

When a serial distribution type of system is used, a distribution box is not required. When it is used, however, the distribution box is subject to the regulations of the local plumbing and health authorities.

Drainage Piping

To dispose of the effluent into the ground, a system of piping or other means must be provided to uniformly distribute the waste water into the leaching area. When piping systems are employed, several types of piping materials may be used. Figure 5 shows several types of one material.

One popular type of piping is known as farm tile. This consists of short lengths of clay pipe that are laid end to end in the drainage trenches.

Another type of piping is the semi-perforated clay piping. This piping is available in 2 to 3 ft lengths and is placed together with the joints left open.

Still another type is the fully perforated clay pipe of the same length. Joints of this piping are also left open to facilitate rapid drainage.

Although this piping has been shown only for the purpose of example, it is up to the engineer designing the sewage disposal system to select the type of piping and material he favors for the installation. Clay piping is

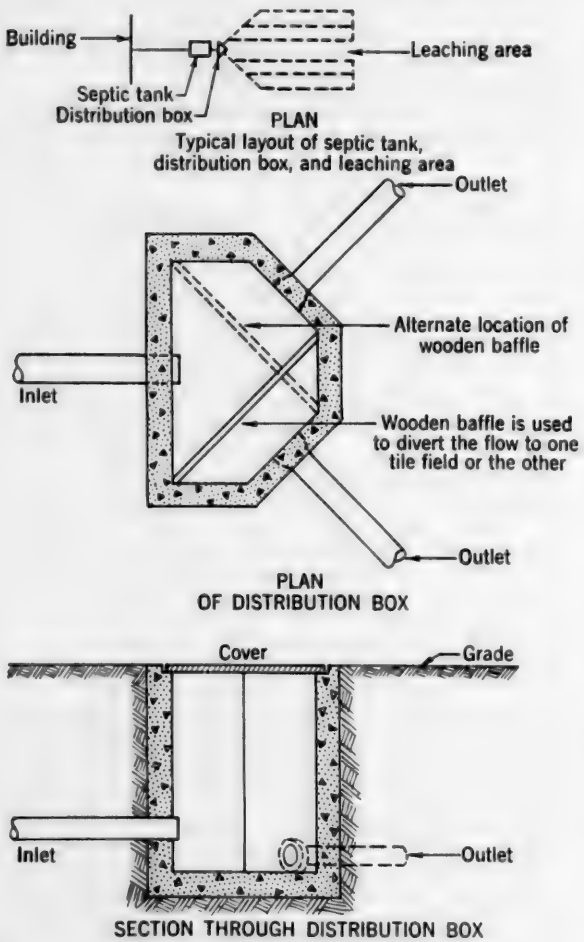


Fig. 4. Details of a distribution box.

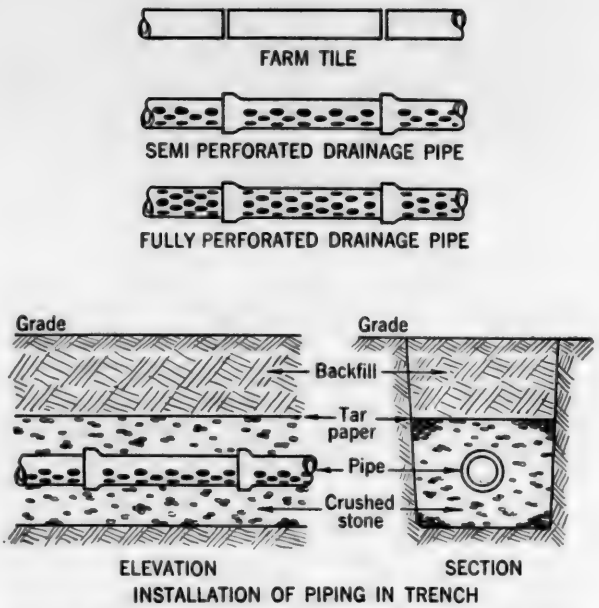


Fig. 5. Details of drainage piping and the typical manner of installation.

available in several different strengths.

The drainage piping is placed in shallow trenches as illustrated in Fig. 5. The trenches must be a prescribed distance apart, dependent upon either the drainage capacity of the soil, the requirements of the local plumbing or health authorities, or the engineers' favored design.

The trenches are carefully excavated, a firm bed of crushed stone applied and the piping adequately installed. The crushed stone is added under, over and around the piping to assure unrestricted drainage. A layer of tar paper is often applied to the top of the crushed stone to prevent the backfill from clogging the drainage capacity of the crushed stone. The backfill is gently added to slightly higher than grade level to complete the installation. When this work is carefully handled, the leaching area can be depended upon for adequate drainage capacity.

The total lineal feet of drainage piping depends upon the absorption capacity of the soil. If the soil has good drainage qualities, the total lineal feet of drainage piping required will be less than that needed for soil of poor drainage capacity. The local plumbing or health authorities will always request test data on the percolation rate of the soil in which the leaching area is to be located.

Seepage Pits

Another method for disposing of the effluent is by means of seepage pits. These pits may be constructed of brick, concrete blocks, poured concrete or other favored construction. A typical seepage pit is detailed in Fig. 6. In this instance, a pre-cast seepage pit is illustrated. This pre-cast unit is available in certain desired heights and diameters. The sections fit together as shown and are then secured with clamps. This structure is a very durable type and is reinforced with steel mesh to provide extra strength. Seepage holes are formed when the structure is poured.

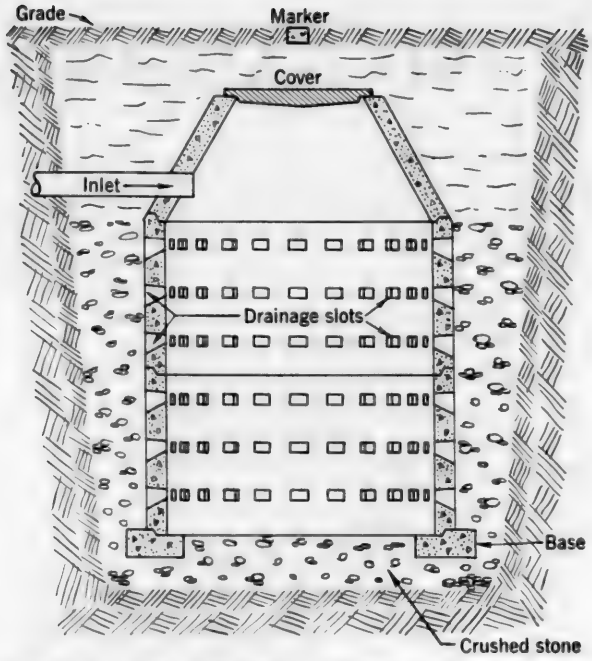


Fig. 6. Details of a seepage pit fabricated out of pre-cast reinforced concrete sections.

To install the seepage pit, a hole is dug, crushed stone applied to the bottom of the hole and then a concrete base poured to support the seepage structure or drywell, as it is commonly called. Next the sections are lowered into the hole and clamped together. A pre-cast cone is placed on top of the section. Removal of a cover on top provides access to the interior, and a marker at grade indicates the location of this cover.

Crushed stone is added around the exterior of the seepage pit. This crushed stone is important because it increases the drainage capacity of the pit. Backfill is then carefully applied up to grade and the seepage pit is ready for operation.

It is timely to mention that seepage pits are usually considered a less-desirable method of effluent disposal than the leaching area or absorption field. Seepage pits should never be used where there is a likelihood of the liquid contaminating underground waters and it should not be used when adequate subsurface disposal fields can be provided. When seepage pits are employed, the pit excavation should terminate at least 4 ft above the ground water table. The local plumbing and health authorities should always be consulted for their regulations governing the design and construction of seepage pits as well as for the limits of application.

Summary

Other procedures concerning sewage treatment and disposal must be provided when demanded by the local plumbing and health authorities. These include filtering equipment, chlorine application and other specialized handling. However, in order to limit the scope of this article, these practices were omitted and will be covered in future articles. When a sewage disposal system is contemplated, the septic tank should be of sufficient size to handle the building load. The means of disposal whether it be drainage piping or seepage pits should be carefully designed and the ground in which the system is installed should be of good drainage capacity. Every precaution must be taken with the disposal system to safeguard underground water supplies.

Environmental Control for Cancer Research

A complicated system of air conditioning and ventilation is working day and night to keep 200,000 mice and rats comfortable. The animals are tenants of the Sloan-Kettering Institute's newly opened Walker Laboratory, in Rye, N. Y., and they play a major role in the Institute's continuing campaign to find a cure for cancer.

Designed and constructed by Wigton-Abbott Corp., of Plainfield, N. J., the laboratory building has three floors and about 95,000 square feet of area, but its air conditioning capacity is approximately 530 tons, usually high for a building of this size.

The reasons for this heavy load stem from the critical nature of the experimental work conducted in the building. The animal rooms are located at the core of the building, and close control of the temperature and humidity in these rooms is essential to the welfare of the animals. Also, to control odors, the animal rooms are supplied with air drawn from outside and electrostatically filtered.

The humans haven't been forgotten either. The 140 individual laboratory modules located around the perimeter of the building are also kept comfortably cool. But since the animals live in the laboratory building, their comfort is an around-the-clock concern. An operating engineer mans a supervisory control center in the basement of the building. Located here is an electronic panel, made by Minneapolis Honeywell, that permits constant control and supervision of the humidity and temperature in the rooms.

An additional precaution was taken with the installation of two refrigerator compressors to insure continuous air conditioning at all times. Should one compressor fail, the animal room systems can be kept operating by switching to the other.

The two compressors are made by Carrier and are located in the boiler room. The chilled water from these units is circulated to the cooling coils of the air handling equipment by two 20-hp Worthington pumps. Also located in the boiler room are two 250-hp low pressure Clever-Brooks boilers, which provide steam to the heating coils of the air handling equipment.

The laboratory features quite a few technical innovations developed by Wigton-Abbott specifically for its operation. Among these are a pneumatic system for the collection and disposal of animal waste, which eliminates practically all manual cleaning in the animal rooms.

NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on the last page for securing additional information about new equipment and materials described in this department.

Air-Cooled Condensers

A line of vertical flow air-cooled condensers is introduced by Halstead & Mitchell, Zelienople, Pa.

Ranging in size from three to one-hundred tons, these ACV units offer a host of advantages, the company re-

ports. Horizontal mounting of the fan and coils means these air-cooled condensers present a lower silhouette. For installation on commercial buildings, this can be an important architectural advantage. Because these units are horizontal in main proportions, roof loading is cut down. Upward draft results in noise being directed away from nearby structures.

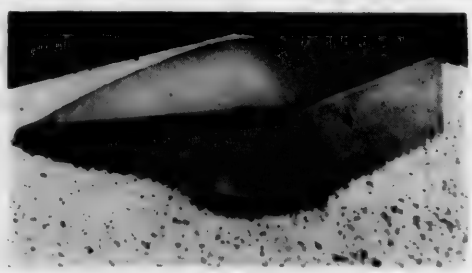
Another advantage lies in performance which is not affected by wind conditions. This provides an extra degree of stability for the entire air conditioning or refrigeration system serviced. The condensers are mounted on legs to cut down hot roof air which might be drawn in were physical clearance not provided.

More information? Circle Item 1, postcard, last page.

Low-Cost Ventilating Skylight

A low-cost power ventilating skylight which provides both ventilation and natural lighting, yet costs as little as an ordinary ventilator, is introduced by Consolite Skylights Div., Consolidated General Products, Inc., Houston, Texas.

Called the Consolite power ventilating skylight, the low-



silhouette unit is a rugged fiber glass skylight with built-in squirrel cage blower. Low initial cost and economical operation make the unit adaptable to all buildings.

Skylight is sturdy but light in weight, and is available in company's self-flashing and curb-mounted designs. Since the blower is factory attached, the entire ventilator skylight unit allows fast, one-piece installation with no duct-work required. Unit is leakproof, shatterproof, and offered in a choice of five colors. An accessory plastic grid is available with extruded aluminum frame for finishing off the ceiling opening.

More information? Circle Item 2, postcard, last page.

Sound Insulating Louver Doors

A soundproof louver door has been designed and made available by Acoustical Div., Elof Hansson, Inc., New York, N. Y.

According to the manufacturer, the door combines all the good qualities of a first-class, soundproof, hollow metal door, plus a sound-trapped air transfer duct.

In private offices, conference rooms, telephone booths, hospital rooms, and in innumerable other places where supply or return air has to pass freely, this door permits air passage without sacrificing the privacy of speech, the company points out.

Door is furnished complete with door frame, pneumatic and aluminum adjustable gasketing, and adjustable threshold sealing mechanism. The certified sound transmission loss is 32 decibels, said to be satisfactory for installation in a 4-inch masonry block wall.

More information? Circle Item 3, postcard, last page.

To Market Electric Baseboard

Embassy Steel Products, Inc., Brooklyn, N. Y., announces that it is marketing electric baseboard. Called Electrobase, the product features dual-voltage (120/240) heating elements to minimize inventory requirements by wholesalers.

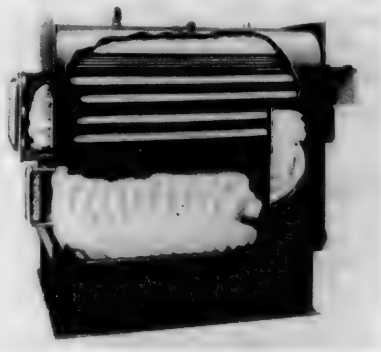
Fins and heating coil tube are bonded mechanically for permanent, efficient heat transfer. The long-lived nichrome wire element is sealed into the aluminum fin tube. The finned element can be reversed to accommodate wiring at either end. Noise-free operation is assured with minimum contact hangers, the company reports.

Five models are available from 1708 to 6832 Btu, in lengths from 2 through 8 ft, with thermostatic controls.

More information? Circle Item 4, postcard, last page.

Three-Pass Boiler

The Portmar Boiler Co., Inc., Brooklyn N.Y., has redesigned its Series TP three-pass boiler to attain the maximum in heating efficiency and economy, it was stated. Claimed to solve today's large-structure heating requirements for steam and hot water, this steel heating boiler



contains several new features. The three-pass system is said to extract full usable heat, resulting in complete absorption of Btu's by the surrounding boiler water. A large steam dome is said to supply a reserve of dry-quality steam, and an added feature, designed for maintenance men, is a gas-tight, rear cleanout door for repair, thorough cleaning and inspection.

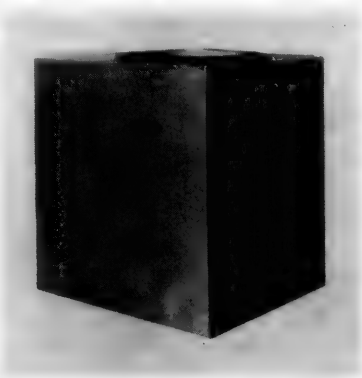
ASME constructed and stamped, and SBI rated, this boiler is available in 16 sizes, oil or gas fired. Steam capacities are rated from 3870 to 45,000 sq ft; water capacities from 6190 to 72,000 sq ft. Working pressure with steam is 15 lb; with water 30 lb.

More information? Circle Item 5, postcard, last page.

Gas-Fired Air Conditioning Unit

The Payne Co., La Puente, Calif., introduces a remote-type gas-fired air conditioning unit. Test models have been in service for the past year in various parts of the country and have proven highly satisfactory and exceptionally efficient, according to company spokesmen.

Unit, which is called the Miracool air conditioner, is an



air-cooled absorption-refrigerated unit which supplies chilled water to a cooling coil. It can be adapted for use with companion upflow, downflow, or horizontal furnace installations utilizing matching coils, or can supply cooling alone with a fan-coil blower unit. The combination installation permits complete year-round gas-fired air conditioning.

The complete installation requires no special wiring, only a 110-volt connection, a gas service connection, and the connection of plastic water lines to the cooling coil. Conditioner is distributed west of Rocky Mountains.

More information? Circle Item 6, postcard, last page.

Electric Water Coolers

Halsey W. Taylor Co., Warren, Ohio, announces the addition to its line of another series of electric water coolers, called Wall-Tite.

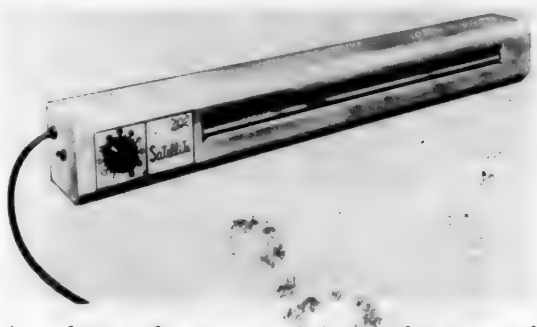
According to the company, this new design follows the trend of today's demand for a cooler with concealed plumbing and a saving in floor space. The cooler rests on the floor, fits snugly against the wall facing, and is easily installed.

This series is available in 6, 11, or 16-gal capacities. The cabinet is only 15¾ inches wide, extends 13 inches from the finished wall, and stands 40 inches high. The stainless steel top (18-8 Type 302), with standard No. 4 polish, has a fully contoured, splash-resistant basin and wall protective shield.

More information? Circle Item 7, postcard, last page.

Compact Printer

Top-quality prints in minutes, at savings up to 80%, are said to be possible with the Satellite printer. Printer is sold by Eugene Dietzgen Co., Chicago, Ill.



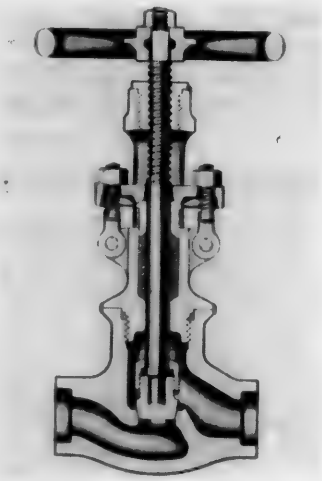
According to the company, it is a perfect answer for factory, school room, engineering or architectural office. Compactly designed, the 5 by 5 by 44-inch unit can be hung on the wall, or placed on shelf or table. One dial controls speed, permits exact reproduction from any translucent original.

Printer handles prints up to 30 inches wide, any length. It may be used with either the ammonia or semi-moist developing process.

More information? Circle Item 8, postcard, last page.

For Power Plant Service

Revision and expansion of its line of lip-seal bonnet valves to cover three distinct pressure-temperature classifications rather than the two groups previously produced is announced by Crane Co., Chicago, Ill. The valves, part of the company's complete line of valves for power plant service, consist of:



Series 3800 1500 lb valves at 850 deg F, made in Crane cast carbon steel: globe, angle and lift-check; Series 3900 of 1570 lb valves at 1050 deg made in Crane #7, (WC-6) cast chrome moly steel: globe, angle and lift-check; Series 4000 2520 lb valves at 1050 deg made in Crane #7 (WC-6) cast chrome moly steel: globe and angle valves.

The lip-seal bonnet valve line, ranging in size from ½ inch through 2 inches, has been redesigned to provide a centering shoulder. This change eliminated any possibility of steam binding or any other difficulty, the company says.

More information? Circle Item 9, postcard, last page.

Crop Drying Fan

A crop drying fan said to move more air per horsepower yet be quiet in operation is developed by Farm Products Div., Chicago Blower Corp., Franklin Park, Ill. A vaneaxial fan, it is electrically driven. Air moving capacities range from 1500 cfm at 4.0 inches of water to 12,600 cfm at 0.5 inches of water.

The fan is fitted with a streamlined air inlet. Air vanes located behind the inlet cut air turbulence, which holds fan noise low. Fan and motor are directly connected, eliminating belt and noise problems.

Two sizes are available, with blade diameters of 18 or 22 inches. The unit may be had with a 3450-rpm motor with horsepower ranging from 1½ to 7½. Altogether, six different models are available, giving the user a wide choice of motor and fan blade hook-ups.

Only a small mounting space is required for any of the six models. Air inlet diameter is approximately 30 inches, fan housing diameter is approximately 22 inches, length is approximately 26 inches on the 22-inch blade models. Dimensions on the 18-inch models are in proportion.

A canvas duct for discharge or inlet connections, electric starter, wire guard for air inlet duct, and gas fired supplementary heaters, are available as accessories.

More information? Circle Item 10, postcard, last page.

Low-Capacity Proportioning Pump

A plunger-type, small-capacity proportioning pump for the accurate and efficient chemical treating of small, low pressure boilers is introduced by B-I-F Industries, Inc., Providence, R.I.

Proportioneers Model 1107 Adjust-O-Feeder provides low-cost injection of boiler treatment chemicals in boilers used in hospitals, apartment houses, schools, motels, etc.

It is well-suited for treating make-up water, or for constant feeding at low rate. In addition, it is suitable for correct proportioning of chemicals in water and sewage works, chemical and food industries, etc.

Design features include adjustable stroke length to give feed rates from 0.2 to 2 gph at 300 lb maximum discharge pressure.

More information? Circle Item 11, postcard, last page.

Duct Silencers

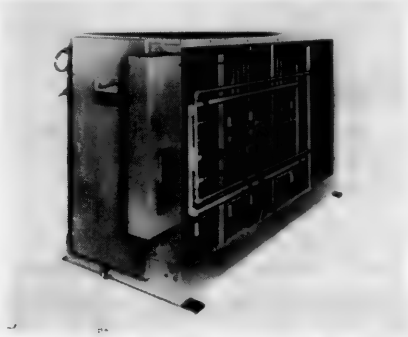
Silentflow duct silencers are offered by Silence, Inc., Farmingdale, N. Y. Available are rectangular silencers for air conditioning systems, in all sizes, and for special applications; also, circular silencers for high pressure air conditioning systems and for all applications using circular ducts. Silencers are guaranteed to meet acoustic specifications.

Company also engineers and builds cooling tower air intake and exhaust silencers, with low pressure drop and high acoustic efficiency, as well as complete acoustic enclosures for cooling towers.

More information? Circle Item 12, postcard, last page.

"In-Line" Assembly for Air Cleaners

Precipitron electronic air cleaners that can be installed as an integral part of air distributing units are now available from Sturtevant Div., Westinghouse Electric Corp., Boston, Mass. These air cleaners match the style and dimensions of the company's air distributing units, and can be assembled "in-line" by bolting directly to them,



becoming part of an integrated system for central plant air conditioning, heating and ventilating.

These electronic air cleaners are designed for application at conventional coil face velocities between 350 and 600 fpm for capacities from 1950 to 28,800 cfm. In-line assembly makes the over-all system more compact since these cleaners are only 25½ inches deep in the direction of the air flow.

The collector plates can be washed either manually or automatically by a moving nozzle. Collected dust is thus flushed and drained away, without any need to enter the ductwork. With the use of Dustik, a cold water soluble adhesive, hot water is not necessary for the washing operation.

More information? Circle Item 13, postcard, last page.

New-Design Centrifugal Pump

A centrifugal pump, said to offer flexibility of application and be capable of effecting substantial cost reductions by conserving weight and space, is announced by R. S. Corcoran Co., Joliet, Ill. The design utilizes the simplicity of two metal stampings bolted together to form a housing which encloses a welded impeller assembly.

Unusually smooth interior surfaces give the pump flow characteristics of high efficiency, the company states. With the same basic pump casing, a wide range of capacities becomes practical merely by varying the impeller design and the motor size. The design and method of fabrication lend themselves to minimum weight while maintaining uniform material thickness throughout the entire assembly. Perfect impeller balance is said to be a built-in characteristic.

Practically any corrosion-resistance requirement can be met by the pump, since the parts are all fabricated from standard alloy sheets. Currently, brass, Monel, and various stainless steels are used; but there is no reason why metals such as titanium, tantalum, and zirconium cannot be considered also. Important in many applications is the fact that the *entire* pump assembly is resistant to corrosion—not just the wetted parts.

While the standard casing is approximately 7 inches in diameter, and 3 to 3½ inches deep, the same design principles can be applied to considerably larger units. The pump is available coupled directly to motor, extended from motor flange for special heat and chemical applications, and with the pump alone mounted on base for coupling to any power supply.

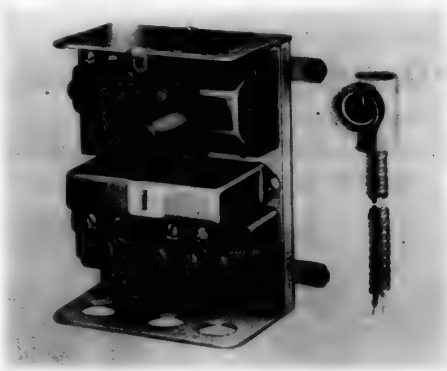
Typical pump and ⅓ hp motor combination weighs only 20 lb. Typical pump applications in connection with heating, air conditioning, and refrigeration equipment are handling the circulation of brine, refrigerants, lubricants, and water at any temperature.

More information? Circle Item 14, postcard, last page.

Two-Piece Oil Burner Control

A two-piece control for commercial and industrial oil burners has been introduced by Penn Controls, Inc., of Goshen, Ind.

The flame detector, designated Type 651, at right in photo, senses the longer wave lengths of the oil fire, but is relatively insensitive to the shorter wave length of the



hot refractory. The combustion relay, Type 652, shown at left, provides dependable one-stage amplification and may be mounted in any convenient location. A spokesman for the company said advantages of the transistorized relay include the dependability of the transistor, the single-stage amplifier circuit, and the fact that no warm-up period is required. Almost instantaneous shut-down is provided on flame failure and a recycling period follows. Controls are available for 120 and 240 volts, 50 or 60 cycle service.

More information? Circle Item 15, postcard, last page.

Two-Stage Refrigeration Machines

A line of 2-stage Tonrac refrigeration machines for applications requiring 400 to 800-ton operating capacity is available from American-Standard Industrial Division, Detroit, Mich. Designed to provide chilled water for air conditioning of large buildings and factories, the units are also adaptable to heat pump applications.

Designated Series 235, unit operates on Refrigerant 11. An outstanding feature, the company says, is its quiet,

vibrationless operation as it maintains a constant chilled water temperature over the complete load range. Capacity is varied by adjustable inlet guide vanes; load control is completely automatic.

Machines are powered by water-cooled hermetic motors, available for operation with 208 to 6600-v current. Hermetic design avoids the need for potentially troublesome shaft seals, field alignment of moving parts, and special multi-step foundations. Compressor housings are of cast iron; impellers are of cast aluminum alloy.

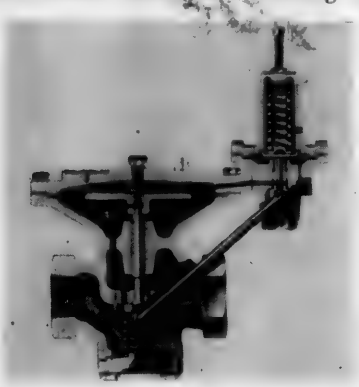
Operating at 3600 rpm, impellers are driven directly, supported on the overhung extended motor shaft. The need for speed gears is thus avoided, producing optimum efficiency.

More information? Circle Item 16, postcard, last page.

Pilot-Operated Reducing Regulator

A new pilot-operated reducing regulator has been developed by Mason-Neilan Div., Worthington Corp., Norwood, Mass., and will be added to its line of pressure regulators.

Designated Model 201-2F, this reducing regulator is



designed to provide accurate control of steam pressure for heating, process supply, and general plant use. It features an easily accessible external pilot, bolted directly to the main valve; stainless steel pilot and main valve; fast, accurate response to pressure changes; large capacity and tight shutoff.

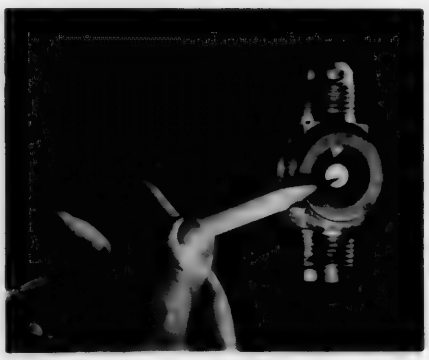
Unit is relatively light in weight, compact, and easy to install and maintain. It offers a selection of reduced pressure ranges and is adjustable over a suitably wide span.

More information? Circle Item 17, postcard, last page.

Moisture-Liquid-Indicator

A mosture-liquid-indicator, featuring a fused sight glass which eliminates all danger of leakage by doing away with gaskets and springs, is announced by Remco, Inc., Zelienople, Pa.

Available for lines from ¼ through 2⅛-inch OD, the moisture-liquid-indicator's interior is given a bright finish



for maximum light reflection. This permits the most minute bubbles or the slightest change in color of the moisture indicator to be readily detected. This is made possible by the use of a polished all-copper body for sizes ⅞ inch and up, and a polished all-brass body for smaller sizes.

The moisture-sensitive element in all of these indicators turns blue when the refrigerant is dry, and pink when moisture is present. The units are designed so that leaching or discoloration is avoided.

More information? Circle Item 18, postcard, last page.

Unit Heater Line Enlarged

Addition of a 30,000-Btu gas-fired unit heater and standardization on 24-volt thermostat controls for the entire line, which is now available in nine sizes, are announced by Carrier Corp., Syracuse, N. Y. According to the firm, the small size heater is suitable for small stores, offices, classrooms, and for residences where additional heat is needed for playrooms, hobby rooms and garages.

The entire line will also have a low voltage transformer for thermostatic control as standard equipment. In addition to giving more sensitive control of temperature, it has a quiet diaphragm valve which starts the unit without an annoying "click." The fan does not start until the heat exchanger is warm and thus avoids cold starts and a resulting draft on the room occupant.

More information? Circle Item 19, postcard, last page.

New Welding Process

A new welding process, called Short-Arc welding, has been developed by Linde Company, Division of Union Carbide Corp., New York, N. Y. It permits manual and mechanized welding of thin material with excellent control of the weld puddle, the company reports. The outstanding feature of this inert-gas consumable-electrode process is the ability to make manual fusion welds in the range of thickness of .030 to .100 inches of all common metals, such as carbon steel, stainless steel, aluminum (.040-inch minimum), copper, etc., in all positions and types of joints.

The process exhibits inherent advantages over other welding methods for welding sheet metal by providing a more readily controllable welding process at high welding speeds, easier production of fillet welds, ability to weld in all positions, and—of significant importance—the ability to weld sheet metal in a range of thicknesses heretofore not considered readily weldable by any process.

More information? Circle Item 20, postcard, last page.

Boiler Water Control System

A side-stream boiler water control system that continuously and automatically keeps boiler water crystal clear by eliminating sludge and suspended solids is offered by Sparkler-Filtrion Corp., North Chicago, Ill.

System is available in standard models for all types of steam boilers up to 1,000 hp and in custom units for boilers up to 6,000 hp. All are guaranteed by the manufacturer to operate boilers at conditions better than industry standards for steam quality guarantees.

According to the company, the systems can save up to 20% on fuel consumption, up to 75% on treatment chemicals, up to 75% on blowdown heat and water losses, and up to 100% on contaminated condensate losses.

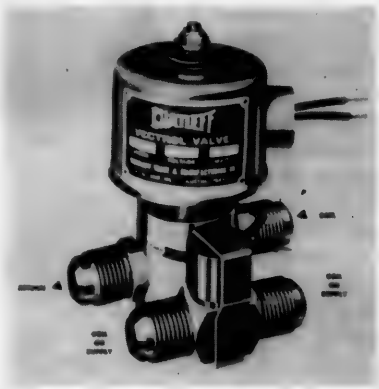
The water control system is based on continuously recirculating boiler water through an effective side-stream filter and filter pre-coat that reduces suspended solids to a value close to zero. New units also combine side-stream filtration with chemical pretreatment, internal treatment, continuous minimum blowdown and feedwater preheating and degassing within the system and are completely automated.

All system models carry a manufacturer's performance guarantee, equipment warranty and one-year service policy. Selection of the correct model depends upon boiler horsepower, makeup water analysis, and percent makeup.

More information? Circle Item 21, postcard, last page.

Diverting Valve Control System

Chatleff Valve and Manufacturing Co., Austin, Tex., introduces Vectrole, a diverting valve control system for hot and cold water circuits. It provides accurate independent unit temperature control, plus self-contained auto-



matic summer-winter switchover. System offers optimum year-round temperature control of air handling units without central or zone controls or wiring circuitry, and permits separate thermostatic temperature adjustment at the individual units.

Consisting of three components, all available separately, the Vectrole is powered from the air handling unit fan leads. It is low in cost, simple, compact, and fully field serviceable. Valve unit is flare-fitted and may be completely serviced without removal from water lines.

More information? Circle Item 22, postcard, last page.

Pressure-Balanced Expansion Joints

A complete line of pressure-balanced expansion joints for absorbing pipeline movement without imposing pressure thrust is announced by Zallea Brothers, Wilmington, Del.

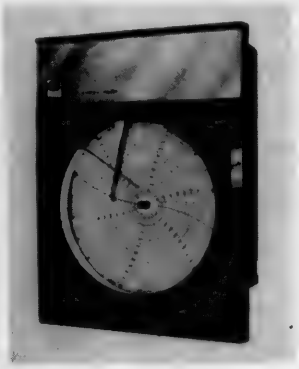
Installed at elbows or points where piping changes direction, these expansion joints use a counterbalancing outer bellows to absorb line pressure where anchoring is not practical.

Expansion joints are available in diameters starting at 3 inches, for temperatures from minus 320 to plus 1600 deg F and pressures up to 2500 psi. Special units are available for more severe conditions. They are available in a variety of bellows: non-equalizing type, self-equalizing type, and HyPTor type. The latter type is also used for lower pressure applications where temperatures are high. After operating conditions have been determined, the company's application engineers can recommend the best design of expansion joint for the service.

More information? Circle Item 23, postcard, last page.

Extends Instrument, Gage Lines

At the Instrument Society of America show, this month in Chicago, new products for instrument users will be among the lines displayed by U.S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa. Several of these products are a part of the company's policy to broaden its line of instruments for process and commercial uses. Others represent continued extensions in the gage lines for commercial as well as original equipment applications.



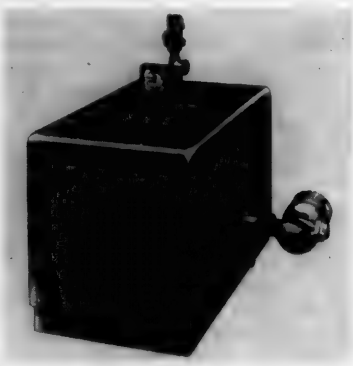
New instruments include: (1) addition of a valve positioner function to the USG Pilot indicating pneumatic controller to provide a two-in-one unit, termed a Pilot-Positioner; (2) a redesigned 12-inch recorder, illustrated, for temperature or pressure; (3) extensions to the line of pneumatic receivers; and (4) a sensitive, non-indicating pressure switch.

Extensions to the gage line are: (1) a high-accuracy, temperature-compensated gage; (2) gages with external zero setting; (3) low-pressure gages with stainless steel diaphragm elements; (4) a line of Grade B all-stainless gages; and (5) a portable field test gage.

More information? Circle Item 24, postcard, last page.

Electric Heating Boiler

An electric hot water heating boiler, designed for radiant panel, convector, baseboard, and radiator type heating systems, is offered by Precision Parts Corp., Nashville, Tenn. Coal, oil, or gas-fired hot water systems can be converted easily and economically, the company states.



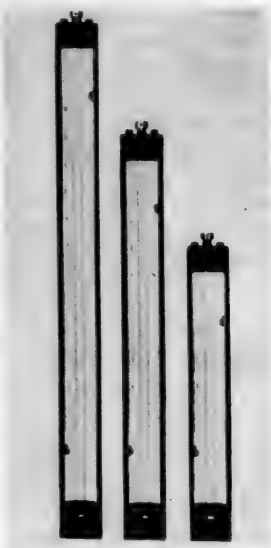
Boiler supplies hot water at temperatures from 60 to 200 deg F and is suited for new or old homes, motels, churches, commercial buildings, and swimming pools. This unit can also be used with a water chiller for year-round air conditioning.

Available in sizes from 40,948 Btu per hr to 2,047,200 Btu per hr, space requirements for the smallest is 20 by 20 by 36 inches; for the largest, 60 by 70 by 108 inches. All requirements of the ASME Boiler and Pressure Vessel Code are met.

More information? Circle Item 25, postcard, last page.

Mercury Pressure Gages

Three low-cost mercury pressure gages with longer ranges for either static or differential pressures are announced by Meriam Instrument Co., Cleveland, Ohio.



The three gages have ranges of 8, 12 and 16 inches to measure maximum static pressures of 4, 6, and 8 lb, respectively. Each unit has a non-spill vent plug atop the housing which when removed exposes a pipe connection used for differential pressure applications.

Based on the principle of the mercury manometer, the gages are said to be permanently accurate and to require no calibration. There are no levers, gears, or other moving parts which will fatigue and affect the calibration of the instrument.

Each gage is equipped with a non-glare duplex scale that reads in both inches and tenths, and pounds and tenths. The indicating tube is made of heavy-wall, heat resistant glass and is recessed into and protected by the durable gage body. A non-spill arrangement prevents loss of mercury through overpressure on mishandling of the unit.

More information? Circle Item 26, postcard, last page.

PVC-Lined Steel Fittings

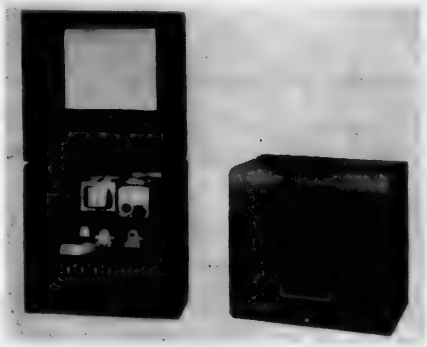
Production of 8-, 10- and 12-inch PVC-lined steel fittings, to increase allowable pressure-temperature limits in the handling of corrosive fluids in large sizes of unplasticized polyvinyl chloride pipe, has begun at Tube Turns Plastics, Inc., Louisville, Ky. Initial production includes 90- and 45-degree elbows as well as tees, with flanged ends or Victaulic grooved ends.

The fittings are rated for 190 deg F and 175 psi test pressure, substantially greater than pressure-temperature ratings for fabricated unplasticized PVC fittings, the company said. Fittings consist of light-wall carbon steel with a fabricated lining of 3/32-inch thick unplasticized PVC. The fittings match Schedule 80 PVC pipe, and the center-to-face and bolt circle dimensions of flanged fittings correspond to ASA Standard B 16.1.

More information? Circle Item 27, postcard, last page.

Combustion Safeguard Control

A combustion safeguard control, called the Protectofier, has been developed by Protection Controls, Inc., Chicago, Ill., for continuous supervision of gas-operated burners in ovens, furnaces, boilers and other heating equipment. The control prevents fires or explosions from build-up of combustible fuel mixtures in either single or multi-burner installations.

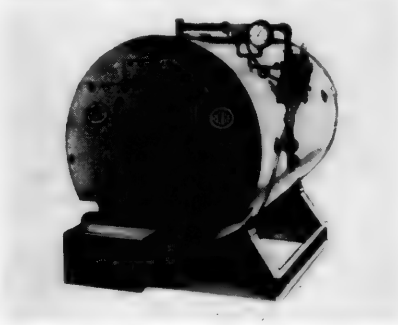


Greater compactness and reduced overall costs are made possible by the elimination of many duplicated components and subsequent wiring expense, the company states. A plug-in sub-assembly, called a Flame-Pak, contains the entire electronic circuit (one for each burner). Any practical number can be used with a single control unit to accommodate multi-burner installations. If a flame failure or fault occurs at any burner position, the signal from the flame electrode to its corresponding Flame-Pak unit is interrupted. This immediately breaks the circuit to the safety shut-off valve, and stops fuel flow to *all* burners in the system. The Protectofier is approved by Factory Mutual Laboratories, and is listed by Underwriters' Laboratories, Inc.

More information? Circle Item 28, postcard, last page.

Scotch-Type Boiler-Burner Units

Pacific Steel Boiler Div., National-U. S. Radiator Corp., Johnstown, Pa., announces a new line of completely packaged steam and hot water scotch-type boiler-



burner units. Designed to meet the requirements of a wide range of applications where low pressure heating and/or process steam is required, the units are available in 20, 30, 40, 50 and 60-hp models for oil, gas or combination oil-gas firing.

Assembled, wired and tested at the factory, each unit is shipped completely packaged ready for immediate operation after piping and power connections are made at the job site. Forced draft firing requires no stack or chimney; only a vent to a point of safe discharge is needed, according to the manufacturer.

"Wet back" design of the units eliminates the need for rear refractory or suspended arch. Three-pass gas flow provides full 5 sq ft fireside heating surface and 80% thermal efficiency certified by the manufacturer.

More information? Circle Item 29, postcard, last page.

Swivel-Clamp Magnifier

A 4-inch, +5 diopter magnifier, equipped with a swivel clamp, is announced by Edmund Scientific Co., Barrington, N.J. Device is seen as having wide application in industry—on work and inspection benches,

draftsmen's lamps, machine tools, and wherever precision instruments require precise setting.

Handy screw clamp with 5/16-inch clearance attaches to electric light housing or any other fixture, and two-ball swivel permits easy adjustment to any position with one hand. Large, 4-inch diameter allows use of both eyes so that 3-dimensional effect is obtained. Precision ground lens has 8-inch focal length.

More information? Circle Item 30, postcard, last page.

Refrigerant Motor-Compressors

Great Lakes Mfg. Corp., Cleveland, Ohio, announces a series of hermetic refrigerant motor-compressors for electronic cooling systems. Compressors are powered by 3-phase, 400-cps motors. Capacities range from 147 to 6150 watts per hr (500 to 18,000 Btu per hr).

Compressors are light in weight, small in size, and may be operated in any position because of their oil-mist lubricating system. Refrigerant and oil mixture is predetermined on the basis of the system in which it is used.

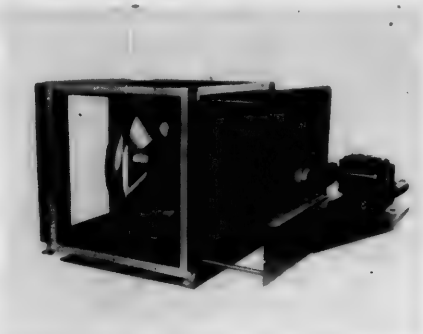
Each unit is designed and tailored to the specific application, with refrigerant, displacement, and motor size based on capacity and conditions required.

Both one-stage and two-stage designs are available. Reverse cycle heating and cooling may be utilized where constant temperature conditions are required within a limited range.

More information? Circle Item 31, postcard, last page.

Packaged Elbow Fans

A new design of elbow fan for general ventilation, and for use with such equipment as furnaces, dryers, ovens, kilns, and plating and pickling tanks, is introduced by L. J. Wing Mfg. Co., Linden, N.J. Standard units can handle clean or slightly contaminated air or fumes at normal or elevated temperatures. Special construction accommodates corrosive or explosive conditions. Installed



in ductwork, the unit occupies only slightly more space than a standard elbow. A choice of three inlet connections is provided.

Motors, available in any type enclosure, are not exposed to hot or contaminated air or fumes. Bearings, located in an insulated shaft tube, are cooled with outside air and are lifetime-lubricated. The entire motor and fan assembly can be removed without disturbing ductwork connections (illustration shows the assembly partially removed).

Wingflow elbow fans are available in five basic sizes with a wide choice of motors, for capacities from 600 to 32,000 cfm at static pressures to 2 inches or more. Standard fans can handle up to 750 deg F; higher temperatures can be accommodated by admitting diluting cooling air.

More information? Circle Item 32, postcard, last page.

More Flexible Metal Tubing

Three grades of flexible tubing in a greatly enlarged range of sizes and materials are announced by The International Metal Hose Co., Bellevue, Ohio.

Made with interlocked construction of strip metal in a

choice of thicknesses from .010 to .034 inches, there is a size and weight flexible metal tubing for every use, the company states. Tubing is now available in galvanized, cold rolled and stainless steel, and bronze.

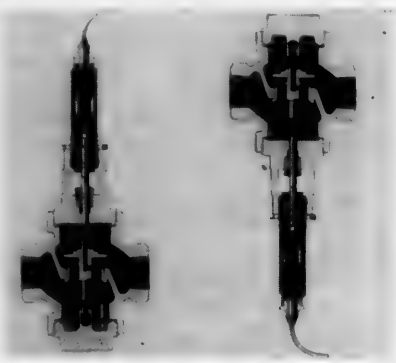
Various weights and metals are available for applications as dust and fume collectors, suction and blower hose, blow-pipe and ventilating systems, agricultural dusters and fog sprayers, armoring and shielding conduit, refrigeration supply lines, domestic and industrial space heaters, hot air duct, bendable tail and exhaust pipes, garage exhaust fume collectors, exhaust hose, hot air heater connections, and flexible spouts.

More information? Circle Item 33, postcard, last page.

Temperature Regulators

Added to its line of temperature regulators by Leslie Co., Lyndhurst, N. J., are two designed for steam and water service.

Designated as Class M (direct acting) for heating service, (photo, left) and Class MR (reverse acting) for cooling service, they are manufactured in ¾ and 1 inch body sizes in both cast iron and bronze with screwed ends. They are self-contained, self-operated. The new design includes a unique balancing bellows which permits smooth functioning at inlet pressures and pressure drops up to 100 psi.



Variations in temperature are sensed by a liquid filled thermo-element which is fully interchangeable to eliminate vapor filling maintenance requirements. Volumetric expansion or contraction of the thermo-element fluid is translated into uniform motion of the valve stem with a precise degree of accuracy and sensitivity. Adjustment for any set temperature is accomplished by hand, by turning of a knurled adjusting sleeve which may be equipped with a calibrated dial.

A large variety of thermo-elements with various ranges, spans and bulb materials are available. Elements can all be interchanged in the field quickly without the need for special tools or training. Further versatility is demonstrated by the feature of being able to reverse the valve action from heating to cooling (or cooling to heating) by interchanging the bottom cap and bonnet assembly.

Applications include instantaneous heaters and coolers, shell and tube or shell and coil heat exchanges, process heating and cooling, as well as space heaters and air conditioning systems.

More information? Circle Item 34, postcard, last page.

(Continued on page 112)

FOR BRANCH CONNECTIONS 2 INCHES OR OVER:

Now! Only 81¢ for a 2" branch fitting!

THAT'S ALL A NEW, READY-MADE W-S FISHMOUTH COSTS

IT'S THE MOST PRACTICAL WAY TO MAKE A BRANCH CONNECTION

Mark

Cut

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The W-S FISHMOUTH saves 50 per cent or more over commercially available branch fittings . . . *costs even less than your own field- or shop-made connection.* Made from Schedule 40 pipe, W-S FISHMOUTH is fully machined and perfectly shaped for strong, leak-proof joints. A ready-made W-S FISHMOUTH is rated for working pressures to 55 per cent of maximum run-pipe limits. Sizes: 2" to 12" IPS, butt weld ends. Fewer sizes handle many more jobs, eliminate need for special fittings.

No time or cost required to shape, fit or bevel. Ideal for close-quarter work. Easy access to inspect weld penetration or to back-weld. W-S factory machining means a secure, permanent installation every time.

Ready-made, the W-S FISHMOUTH costs less to buy and install than anything you can buy or make. Write, today, for complete information, prices and names of distributors to: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

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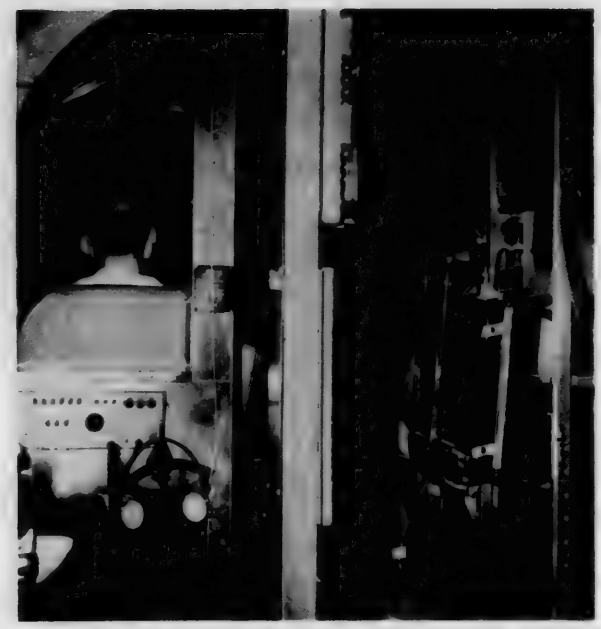


Interior view EAL DC-7 B simulator.

THERMAL

Helps Keep Pilots Cool

In a business where safety is paramount, pilot efficiency and equipment dependability are prerequisites. And, in the flight simulator building* of Eastern Air Lines in Miami, four big Thermal central plant units prove their dependability to provide year 'round comfort for flight personnel practicing instrument flying.

Thermal Engineering manufactures a complete line of air conditioning and ventilating equipment for every climate and to fit all architectural requirements. To see how easily, economically and efficiently Thermal equipment will fit into your new building or remodeling plans write for complete information on Thermal central plant and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils and air-cooled condensers.

*Architects: Stewart-Skinner Associates, Miami
Consulting Engineers: R. L. Duffer & Associates, Miami
Thermal Agent: A. C. Dean Co., Miami

Agents in principal cities.

Quality Products Since 1945

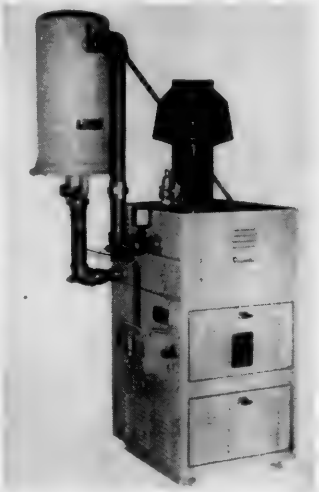
THERMAL ENGINEERING CORPORATION

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

(Continued from page 110)

Swimming Pool Heater

Raypak Co., Inc., El Monte, Calif., announces the addition of the Lifelong indirect swimming pool heater to its line of direct-fired swimming pool boilers. This heater is guaranteed for 20 years and is reported to be the only unit on the market offering such an extended term.



Heater contains two heavy-duty 1-inch copper coils connected in parallel in order to take the full swimming pool filter flow. Absolutely no bypass is required. Flow rates between 30 and 40 gpm will produce a temperature rise as low as 7-10 deg F without fear of condensate. Such high flow rates will, in addition, have a scrubbing effect on the internal walls of the coils. The combination of low temperature rise and high flow rates protects the heater from scaling, the company states.

Since the boiler to which the heater is connected is on a closed system, using continuous recirculation of the initial fill water which is provided from the filter pump and retained within the boiler, there is no corrosion, scaling, electrolysis, or possibility of rust, according to the manufacturer.

More information? Circle Item 35, postcard, last page.

Glass Tinting Product

A new glass tinting product developed and manufactured by Du Pont is described as a sun control measure for all types of buildings. The product, called Sun-X glass tinting, provides the convenience of factory-tinted glass at a fraction of the cost, according to the distributor, American Glass Tinting Corp., Houston, Tex.

The tinting is especially in great demand when renovation, remodeling and air conditioning budgets are prepared. The unique liquid plastic is applied directly to the inside of windows to reduce fade, heat and glare. The bigger the building, the more money is saved through lower air conditioning costs, it is reported.

Tests have shown that Sun-X glass tinting will reduce the heat load through windows up to 82%. The product will reduce ultra-violet rays—which cause fade—by as much as 99.5%, and glare is cut down as much as 91%, the company states. After the glass has been tinted, the window can be washed in the same manner as before.

More information? Circle Item 36, postcard, last page.

(Continued on page 114)

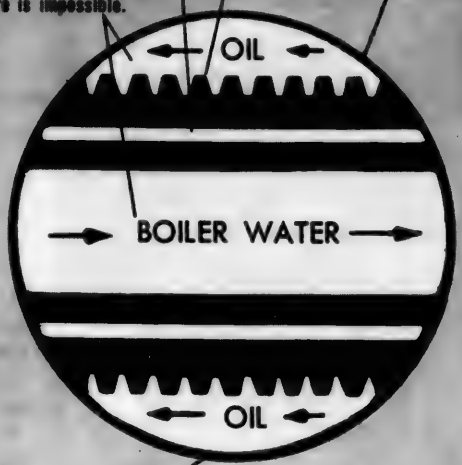
HOW TO USE BOILER WATER DIRECTLY IN A NO. 6 FUEL OIL HEATER WITHOUT DANGER OF SYSTEM CONTAMINATION

THERMO-FILM* —the safety barrier heat transfer liquid—is extremely thin to maintain maximum heat transfer.

EXTENDED SURFACE of outer tubes substantially reduces size and weight of heater.

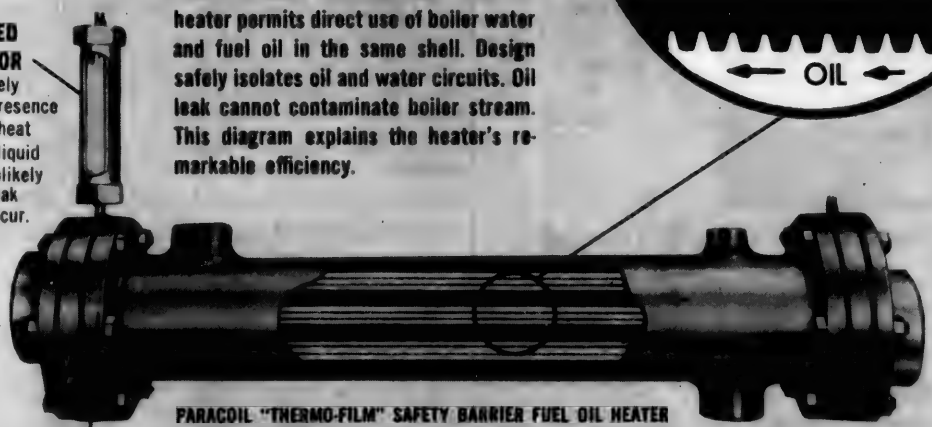
COMPLETE ISOLATION of boiler water and fuel oil is accomplished by a coaxial tube assembly, with heat-transfer liquid between inner and outer tubes. Boiler contamination in event of oil tube failure is impossible.

100% COUNTER FLOW results from straight tube construction. Heated oil exits at end where boiler water enters at its highest thermal head—another design feature assuring maximum overall heat transfer.

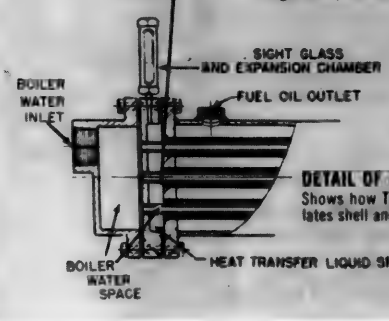


This Paracoil Thermo-Film* fuel oil heater permits direct use of boiler water and fuel oil in the same shell. Design safely isolates oil and water circuits. Oil leak cannot contaminate boiler stream. This diagram explains the heater's remarkable efficiency.

IMPROVED INDICATOR immediately reveals presence of oil in heat transfer liquid in the unlikely event a leak should occur.

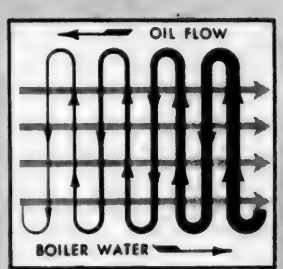


PARACOIL "THERMO-FILM" SAFETY BARRIER FUEL OIL HEATER
Low pressure model—for gravity or forced circulation of boiler water. Provides maximum capacity with minimum size. Also available but not shown: high pressure models, for use with high temperature hot water or steam as the heating medium.



DETAIL OF END CHAMBER
Shows how Thermo-Film* isolates shell and tube side fluids.

INTERNAL TURBULENCE
Oil, with low pressure loss, passes in baffled flow across heating tubes — further increasing heat transfer rates and reducing bulk of the heater. (Thickness of oil flow line represents viscosity).



*Trade Mark Reg., U.S. Patent Office

Paracoil HEAT TRANSFER EQUIPMENT

For details, write for Bulletin 60-N

DAVIS ENGINEERING

(A Division of American Metal Products Company)

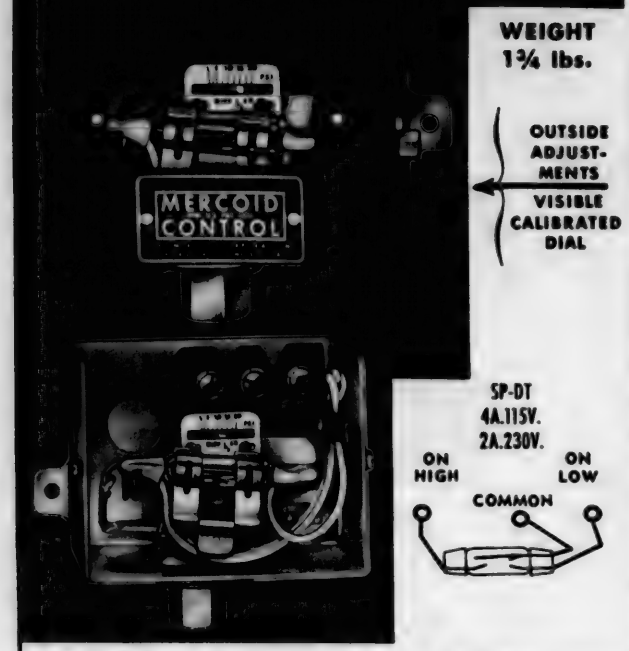
520 Main Avenue, Wallington, N. J.

AN **amp** SUBSIDIARY

NEW Small, Lightweight

MERCOID

PRESSURE CONTROL



For Mediums Not Injurious To Steel Or Silver Solder

Type AP-153 control incorporates a single pole, double throw Mercoid hermetically sealed mercury switch (4A. 115V., 2A. 230V.). The control will provide single pole cut-in high; single pole cut-in low, or single pole double throw operation.

OPERATING RANGES

ADJUSTABLE OPERATING RANGE	SWITCH DIFFERENTIAL PSIG. With Pointer Set At		MAXIMUM LIMITS SURGE
	LOW	HIGH	
1 to 20 psig.	0.3	0.5	30 psig.
1 to 30 psig.	0.4	0.75	40 "

ADJUSTMENT: External.
PRESSURE ELEMENT: Fairprene diaphragm.
PRESSURE CONNECTION: ¼" I.P.S.
MOUNTING: Has two mounting ears (one on each side of control) or control may be pipe mounted by means of the ¼" I.P.S. bottom connection.
WIRING ENTRANCE: Two ½" openings
INTERNAL WIRING CONNECTIONS: 3 post terminal block.
SWITCH LEADS: Silicone rubber covered.
CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front) finished in charcoal-gray.

WRITE FOR BULLETIN 02

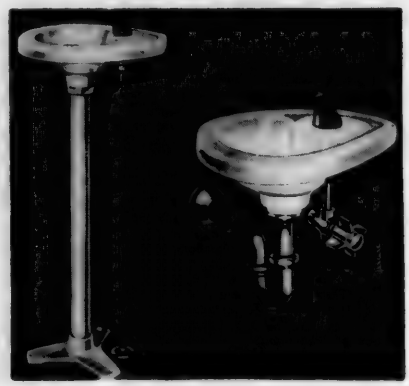
THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.
New York: 205 E. 42nd St. - Philadelphia: 3127 N. Broad St.

(Continued from page 112)

Two Drinking Fountains

Two drinking fountains, with elongated oval design and a circular shaped bowl, are announced by American-Standard Plumbing and Heating Div., New York, N.Y.

The Yukon and Raritan fountains—the latter mounted on a pedestal—include an angle stream anti-squirt bubbler with an integral guard which assures water falling clear of the bubbler head. The bubbler pad is elevated ¼ inch over the critical level of the bowl so that water splashed on the rear deck will run back into the bowl. The fixtures include a self-closing valve with automatic or manual volume regulator.



Both fountains are made of enameled cast iron and are available in white only. The pedestal for the Raritan is available in two sizes, for heights of 30 and 36 inches.

More information? Circle Item 37, postcard, last page.

New Dial Thermometer

A new dial thermometer, featuring increased dial readability for ranges up to 1100 deg F, is introduced by The Partlow Corp., New Hartford, N.Y.

Thermometer, designated Model TMF, has a reinforced plastic case, designed by Raymond Loewy Associates, and may be either flush or wall mounted. It has a large, easily-read dial, and is furnished in a blue-gray color. Other colors are, however, available on special order. Ten scale ranges are applicable with this instrument, according to the company.

Elements of the same scale range are interchangeable. This allows field replacement of element, eliminating the necessity of sending the entire instrument back to the factory.

More information? Circle Item 38, postcard, last page.

Chemical Solution Pump

A low-cost, positive-displacement, chemical solution feed pump is introduced by Bruner Corp., Milwaukee, Wis. The Model 17 pump can be used for red water and corrosion control, chlorinating and sterilizing drinking water supplies and swimming pools, neutralizing acid water, and feeding common chemicals used in water treatment.

Pump provides constant feed adjustable to 17 gal per 24 hr and is adjustable while in operation. It is corrosion-proof, as parts in contact with chemicals are made of plastic or rubber. Transparent pumping head and check valves allow easy observation.

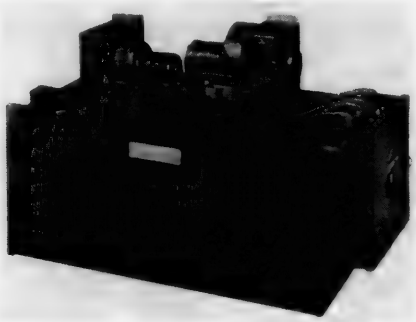
Of compact design, the pump has a special, all-purpose, mounting feature. It is precision-metered for high accuracy solution feeding. The complete pump package includes power drive, electric cord, 10 ft of plastic tubing, foot valve, automatic injection nozzle check, and an instruction manual.

More information? Circle Item 39, postcard, last page.

Small Dehumidifier

Development of a compact air dryer for continuous dehumidification of laboratories, test rooms, and small storage areas has been announced by Dryomatic Corp., Alexandria, Va. Designated Model 50, the machine is the smallest in its line of dual-bed desiccant-type dehumidifiers produced for commercial and industrial installations.

Designed to provide a continuous, low-volume flow of dehydrated air, the unit will find particular application in climatic chambers, drying cabinets, chemical processing, and for storage of paper products.



Unit 50 removes up to 24 lb of water per 24 hr, and can hold 10% relative humidity in confined spaces up to 17,500 cu ft. The machine delivers a constant flow of 50 cfm dry air by alternate utilization of two beds of permanent silica gel drying agent. While one bed removes moisture from the air, the other is regenerated by built-in electrical heating elements which vaporize the adsorbed moisture and exhaust it outside the dehumidified space. Fully automatic on-off control is provided by a hair-element humidistat.

Machine meaures 37 by 17 by 23 inches and weighs 185 lb.

More information? Circle Item 40, postcard, last page.

That's the big story behind the NEW

CORDWALL COOLER

Here's the most important improvement in electrical water coolers in 30 years... the all-new Cordwall Cooler. It's off the floor, flush with the wall and it conceals all plumbing.

Reception by industry, commerce, schools and institutions has been tremendous.

The Cordwall saves up to ⅔ of the space needed by standard coolers. It can be installed at any convenient height. It's *the* modern, attractive and extra-efficient cooler you should consider for your next installation or replacement.

Write for the name of your nearest Cordley distributor and bulletin #WH-59 today.

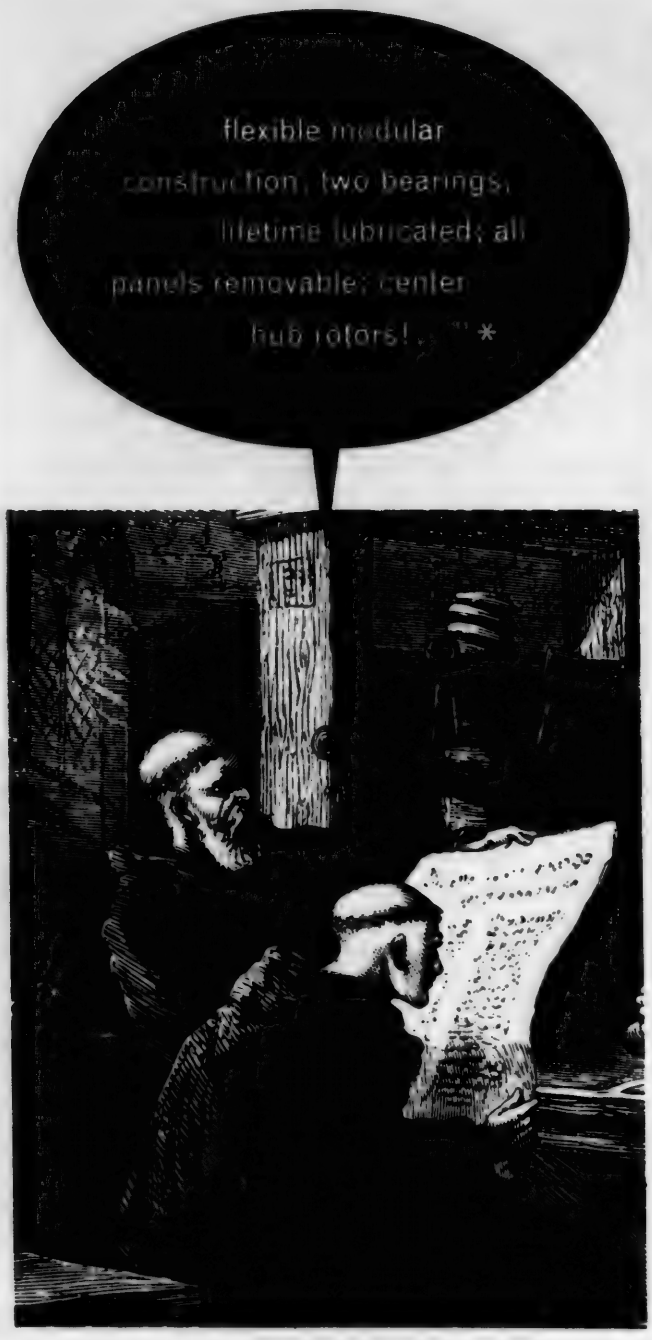
Cordley

There are 22 other Cordley Electric Water Coolers, too.

1717

CORDLEY & HAYES

443 Fourth Avenue, New York 16, N.Y.



* "...and packed with many more facts in a just-printed, 48-page catalogue about what D-H *now* offers you in its popular 30-model central station air conditioning units (horizontal and vertical). Handy time-saver fan performance curves included, too!" Contact direct for Engineering Manual No. CSHV 312, and name of Manufacturer's Agent nearest you. *Send for yours.*

MEMBER OF AMCA

drayer-hanson

DIVISION NATIONAL U.S. RADIATOR CORP

3301 MEDFORD ST., LOS ANGELES 63, CALIF.
CABLE: CLICONI, LOS ANGELES

Classroom Sink Unit

An island sink unit has been added to the company's line of all-steel classroom equipment, it was announced by Grade-Aid Corp., Nashua, N.H. This modular unit offers accessibility from all four sides when installed as an island sink, or three sides in a peninsular type of

installation. A choice of 3, 4, or 6-ft widths combines with six heights to fit any classrom need, from kindergarten to high school.

Specifiers may choose a one-piece complete stainless steel top or a heavy-duty Melamine plastic top (illustrated), both of which are designed for years of hard wear, resistance to dents and scratches, and convenience in keeping clean.

All sink units are shipped complete with fixtures, leveling bolts, and sliding doors, ready for installation, and are factory guaranteed. Optional items include squirtproof bubbler and gooseneck-type faucets. There are two colors available and three types of doors—all-steel, pegboard, or plastic woodgrain.

More information? Circle Item 41, postcard, last page.

Accurate Pressure Gages

A series of what are described as extremely accurate pressure gages, known as the Master-test line, is announced by Marsh Instrument Co., Skokie, Ill. Made in all standard pressure ranges, and in compound and vacuum types, the gages are individually dead-weight tested and guaranteed accurate within plus or minus ¼ of 1% of the maximum dial reading over the entire range.

To assure accuracy of reading in keeping with the greater accuracy of the instruments, a new type of dial, called the Read-easy, has been developed in which an inner arc shows major marking and an outer arc shows the finer graduations—a new type of scale which permits the gage to be read with the accuracy of a caliper rule, the company reports.

Further accuracy is obtained by three reading methods: a twin-tip or gun-sight pointer; a new type of mirror scale; and a "non-parallax" dial from which the observer always obtains a correct reading even when the dial is read at an angle.

More information? Circle Item 42, postcard, last page.

Heavy-Duty Ventilating Fans

A line of heavy-duty Breezemaker ventilating fans, with six, seven and eight-foot blade diameters, is announced by Monarch Electric Co., New Britain, Conn.

Designated the Type E line, fans are rated from 45,000

to 175,000 cfm, and are designed to eliminate the high installation and maintenance costs of smaller light-duty fans in laundries, garages, warehouses, auditoriums and industrial plants.

Line meets NEMA standards for safety and is offered with open, totally enclosed or explosion-proof motors for every normal or hazardous application. Motors range from ½ to 20-hp. Shown in photo is installation of an 8-ft fan in large department at Fafnir Bearing Plant.

More information? Circle Item 43, postcard, last page.

Three-Way Solenoid Valves

Series L3 high-flow, three-way, solenoid valves for general industrial use are announced by Skinner Electric Valve Division, New Britain, Conn.

Designed to control such common media as oil, air, water, vegetable and petroleum oils, inert gases, kero-

sene and gasoline, valves are compact, light, mount in any position directly to the line, and operate on a pressure differential of 5 to 150 psi. The company is introducing these valves in ⅜-, ½- and ¾-inch full effective orifice sizes and is making them available normally open, normally closed and with directional control in standard and explosion-proof construction. It also is offering them in a wide range of voltages and frequencies with many electrical options.

More information? Circle Item 44, postcard, last page.

Safer because it's Simpler

■ Of all boiler water level controls, we believe Magnetrol to be the safest. Certainly it is the simplest.

A PERMANENT Alnico magnet, located *outside* the float chamber, links boiler water level and electrical controls. This infallible magnetic link eliminates mechanical parts normally subject to wear and fatigue failure. *Pioneered and perfected by Magnetrol,* it provides almost unlimited operating life.

The brass "No-Scale" float chamber liner, another exclusive Magnetrol feature, is self-cleaning. It actually "flexes" off scale and prevents "sticking" of the float.

A magnetic sleeve, raised and lowered within a non-magnetic tube, "trips" or releases an Alnico permanent magnet attached to a mercury switch. Basically, this is Magnetrol.

These are just two of *many* advances for greater boiler safety found *only* in Magnetrol. *Standard* Magnetrol units are available for temperatures up to 750°F., at pressures up to 600 psi, for single stage (low water cut-off) or multi-level stage (pump control *plus* low water cutoff and alarm) service with as many as three separate switching actions. Special units are available for more extreme requirements.

MAGNETROL, Inc.

Mail the Coupon Now for the Facts

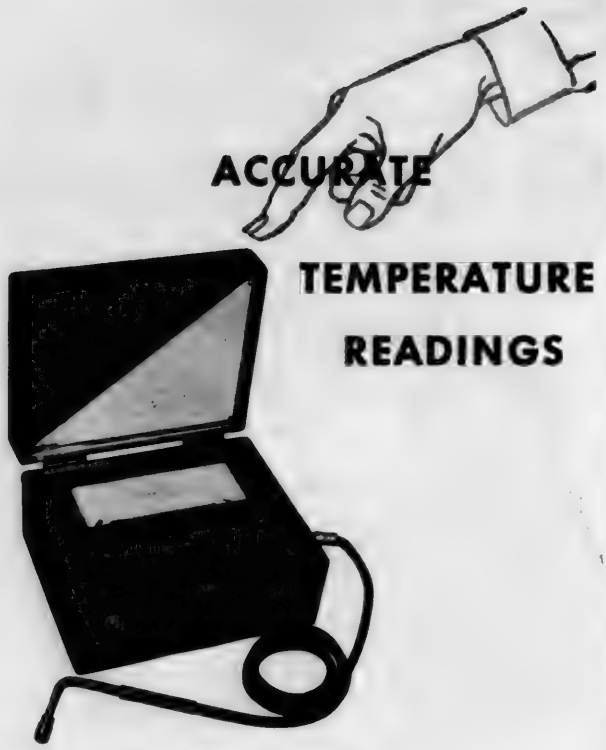
MAGNETROL, INC., 2106 S. Marshall Blvd., Chicago 23, Ill.
Gentlemen: Please send me Catalog Section III and full information on Magnetrol Boiler Water Level Controls. 9

Name _____

Company _____

Address _____

City _____ Zone ____ State _____



- Hot Water Systems
- Floors, Walls, Ceilings
- Refrigerated Coils
- Insulation
- All Other Low Temps.

You can accurately read any low surface temperature with the Alnor Type 2300 Surface Pyrometer—in 3 to 5 seconds.

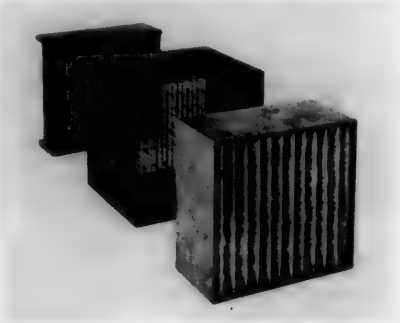
Take this rugged, portable instrument to any job in the field and see how performance to laboratory standards can save invaluable time in balancing out a system...save the money lost on call-backs. Large 6" mirrored scale is direct reading, no conversion...no errors in readings ...1° per division. Precision jeweled movement is protected against abuses of portable service by sturdy walnut case. Comes complete with matched thermocouple and lead ready to use on your next trip out. Send for Bulletin 4257 and get the complete story on the full line of Alnor Pyrometers. Just tear out this ad and mail on your letterhead to: Illinois Testing Laboratories, Inc., Room 514, 420 N. LaSalle St., Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

Frame for Dust-Odor Filter

A combination Aerosolve-Charcoal filter frame, especially developed to provide a compact filter bank for both dust and odor removal, is introduced by Cambridge Filter Corp., Syracuse, N. Y. The upstream portion of this permanent steel frame holds a standard 12-inch deep Aerosolve filter cartridge in a choice of 95%, 85%, or 35% discoloration efficiency on atmospheric dust. The downstream end is designed for easy installation of an



activated charcoal filter of the user's choice. The entire unit—frame, Aerosolve filter and activated charcoal filter —can be supplied by the company as a complete package. The high-efficiency filter effectively protects the charcoal filter from plugging with dust and loss of odor-removal capacity. With this combination frame, installation and servicing are greatly simplified and access space minimized. Unit has a capacity of 1000 cfm and overall dimensions are 24 x 24 x 21 inches.

More information? Circle Item 45, postcard, last page.

Fountain-Cuspidor Combinations

Conforming with the simple architecture of today's schools, Kohler Co., Kohler, Wis., announces a new

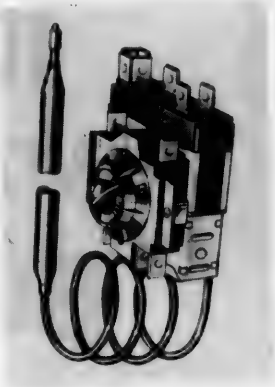
series of recessed and semi-recessed drinking fountain-cuspidor combinations for gymnasiums.

The drinking fountains have non-squirting bubblers located at a convenient height and angle. Metal guards protect the users against mouth contact. Cuspidors feature chromium-plated brass spreader, supply pipe from by-pass valve on fountain, strainer and brass trap with cleanout extension to wall. Fountain-cuspidor combinations are of smooth, square design to simplify cleaning and maintenance.

More information? Circle Item 46, postcard, last page.

Cycling Thermostat Controls

Slim-line design that permits shallow depth mounting, and convenient side access to terminals for fast, easy servicing are among the chief advantages offered by a pair of cycling thermostat controls for air conditioning equipment recently introduced by Ranco, Incorporated, Columbus, Ohio.



Designated the C21 (illustrated) and C22 Series, the controls are designed to operate window or unit air conditioners, compressors, strip heaters and reverse-cycle heat pumps under cross ambient conditions in a wide variety of applications.

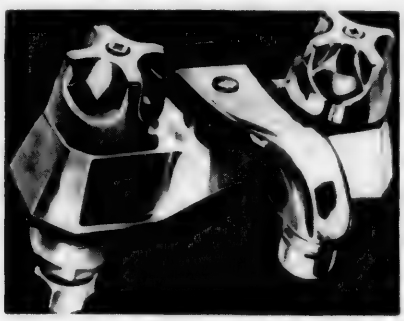
A new "dial-within-a-dial" rotary selector switch, available as an optional feature on both models, is another important advantage provided by the units, according to the manufacturer.

More information? Circle Item 47, postcard, last page.

Commercial Centerset

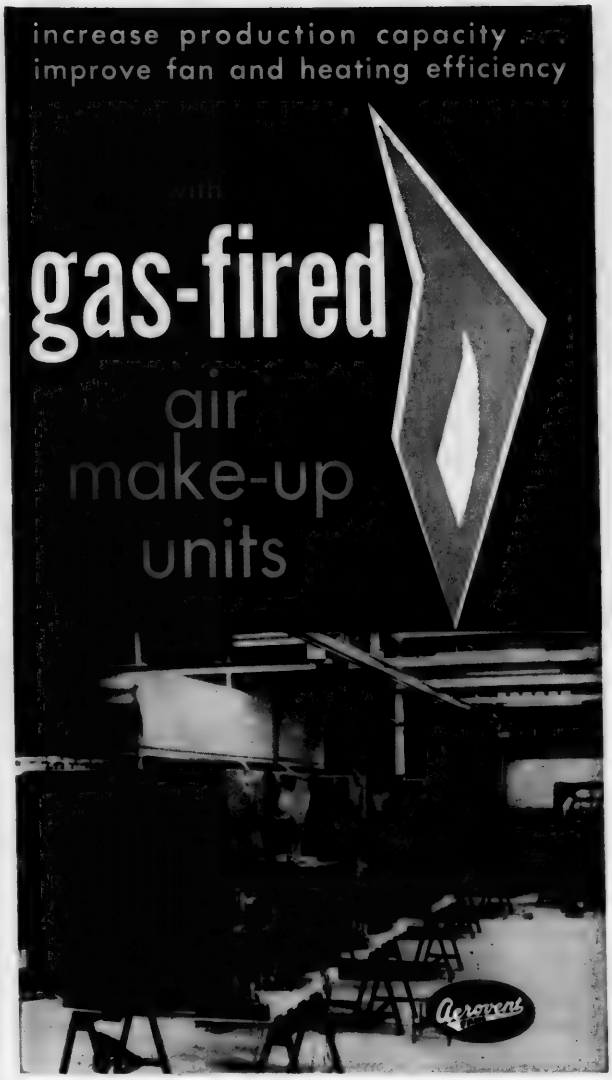
A new heavy-duty 4-inch centerset combination lavatory fitting, with the company's self-seating closure is available from Kel-Win Mfg. Co., Inc., Richmond, Va. This fitting is ideally suited for use in public washrooms, hotels, motels, dormitories, hospitals and other places where the work load is heavy, the company states.

The self-sealing principle operates by a cam and



straight-lift piston action. Unlike the spring-loaded faucet that snaps shut when released, these faucets remain open at any desired water flow, leaving both hands free. But final closing and seating is automatic. The person using faucet starts the closing operation by hand but, before a half turn is accomplished manually, two things happen: the vertical piston and stem is in *free* position, and a spring takes over to close or seat the valve; and, at the same time, water pressure pushing up against the bottom of the valve in the direction of closing applies pressure, helping to seat the valve and insure a positive and permanent seal.

More information? Circle Item 48, postcard, last page.



Pictured above is a portion of the final assembly line at Aerovent showing 8 units slated for delivery to a large Midwestern automobile accessory manufacturing plant. Designed to supply ample quantities of clean, pre-heated or cool, outside air to replace air exhausted by ventilating systems, the Aerovent Gas-Fired Air Make-Up Unit keeps air fresh; eliminates drafts and negative pressures. Safe, dependable operation and automatic, semi-automatic or manual control with natural, mixed, manufactured or propane gas.

For winter or summer use, these compact, packaged units are available in four unit arrangements and four sizes from 36" to 54" for various capacities, BTU ratings and pressure conditions.

Write for bulletin 880.

OTHER UNITS AVAILABLE FOR STEAM OR HOT WATER

Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

CERTIFIED PERFORMANCE

Aerovent

FAN COMPANY, INC.

Ash and Brandt Streets Piqua, Ohio

Solution Feed Pump

A low-cost solution feed pump, called the No. 77 Solution Feeder, used for chlorinating home well water systems or introducing phosphate or mild alkali treatment to control scale, corrosion and red water is available from Calgon Co., Pittsburgh, Pa.

The small, electrically operated, diaphragm pump has a feed rate adjustable from one pint to three quarts per hour and will feed into any water line having up to 100 psi pressure. Besides chlorinating to make water safe to drink, the unit can feed hypochlorite solutions to precipitate dissolved iron and hydrogen sulfide in conjunction with filtering systems.

More information? Circle Item 49, postcard, last page.

Air Sampling Kit

An air sampling kit is available from Gelman Instrument Co., Chelsea, Mich. This instrument combines vacuum pump, flowmeter, and weather-proof housing. The kit can be used to collect samples of dusts, radioactive

aerosols and gases. For determining dusts in air, special filters and filter holders are available as accessories.

The vacuum pump used is a carbon-ringed piston unit which never requires lubrication. A choice of 2 or 4-cfm air capacity is offered. The flow indicating device is a tapered-orifice plastic meter.

Instrument has uses in collecting dusts and gases for analysis in air pollution studies, health physics surveys, safety-health work and process efficiency tests. The determination of air-borne dust has become increasingly important in precision instrument and electronic work where small particles cause component malfunction.

More information? Circle Item 50, postcard, last page.

WATCH FOR THIS

Next month's (October) Reference Section covers Design and Cost Data for Ice Rinks of all types. It will be the most comprehensive collection of application data ever published on this subject.

Whether you are interested in the design of ice skating rinks or are investigating costs for a client, you will find this article valuable.

YOUR IDEAS WORK BETTER WHEN YOU WORK WITH HONEYWELL

THE FOLLOWING pages bring you some of the latest developments in automatic controls from Honeywell. They widen your choice of products; give you more to work with.

For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 sales offices throughout the country. Each is staffed with control specialists to assist you in writing specifications and preparing control layouts.

Honeywell's new Selectographic DataCenter* features modular design!

It simplifies application, adds new economy to centralized control!

THE HONEYWELL DataCenter lets one man do the work of a crew—set temperatures, make adjustments, supervise critical areas of an entire building's air conditioning system from one central location.

And Honeywell's modular building block design gives greater economy, new flexibility. Starting with the basic unit—the central Selectographic Console—modules of a standard 2′ by 2′ dimension may be added as the need arises or as budget permits. Honeywell's Selectographic DataCenter can be installed in buildings of all sizes, for all purposes; can grow with your needs.

For more information about this panel, call your local Honeywell office. Or write Honeywell, Dept. HV-9-92, Minneapolis 8, Minnesota.

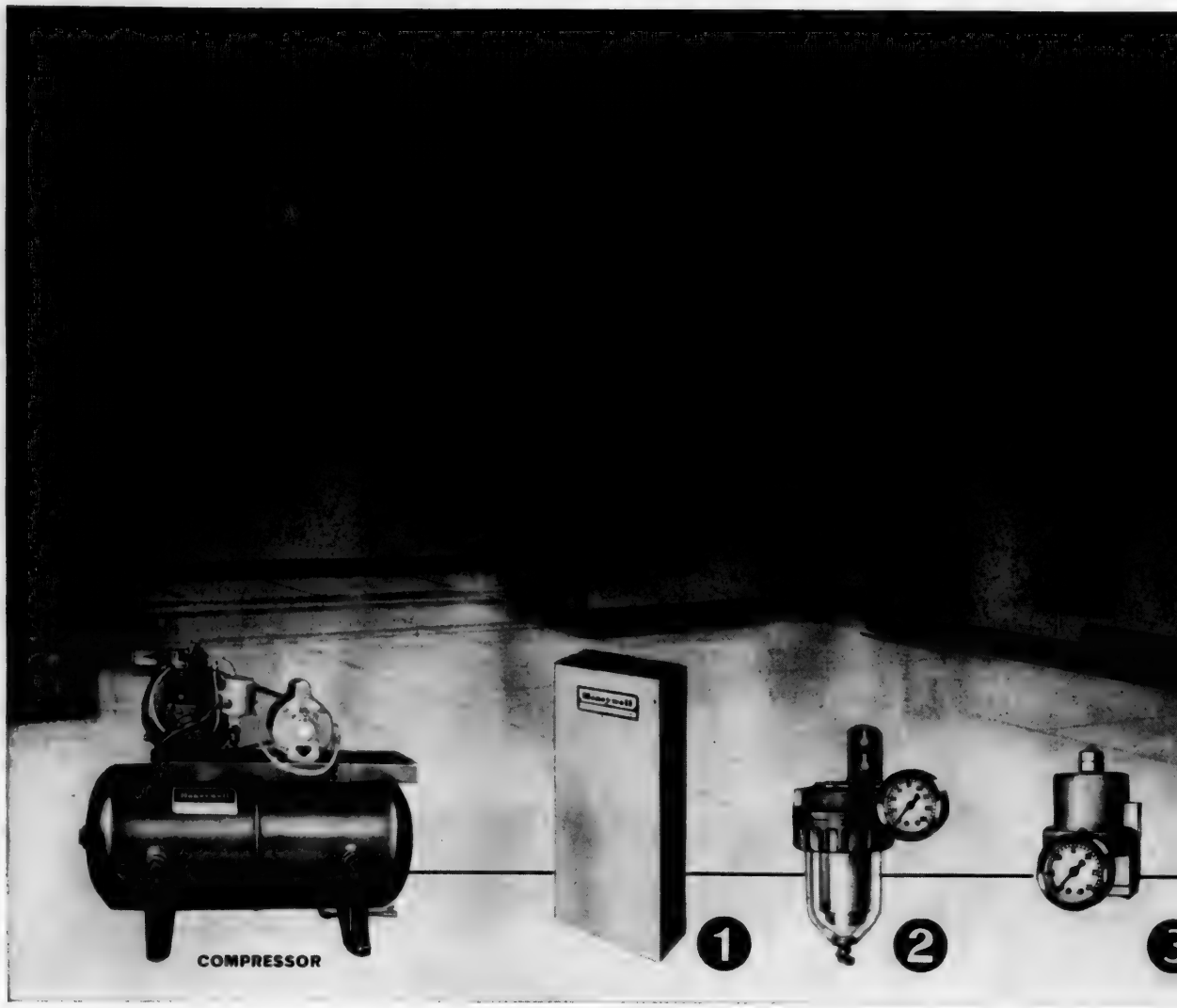
*Trademark

FOR MORE TO WORK WITH WORK WITH HONEYWELL

Honeywell

First in Control

Now you can maintain stability, pow
performance in Central Fan Control



Protect your pneumatic control system with Honeywell's Dryer, Filter & PRV Station

To maintain top performance and avoid corrosion in your pneumatic control system, the air must be properly cleaned and dried, with its pressure reduced to the exact control pressure. These new Honeywell products assure continuing top performance by protecting your precision pneumatic controls from corrosion and dirt. This assures you of a longer, trouble-free life from your pneumatic control system.

With the largest field force in the industry—in 112 offices across the country—Honeywell gives the most convenient, prompt, efficient service.

Specify the entire line of Honeywell pneumatic controls . . . the very finest in the world. For more information, call your nearest Honeywell office, or write to Minneapolis-Honeywell, Department HV-9-132, Minneapolis 8, Minnesota.

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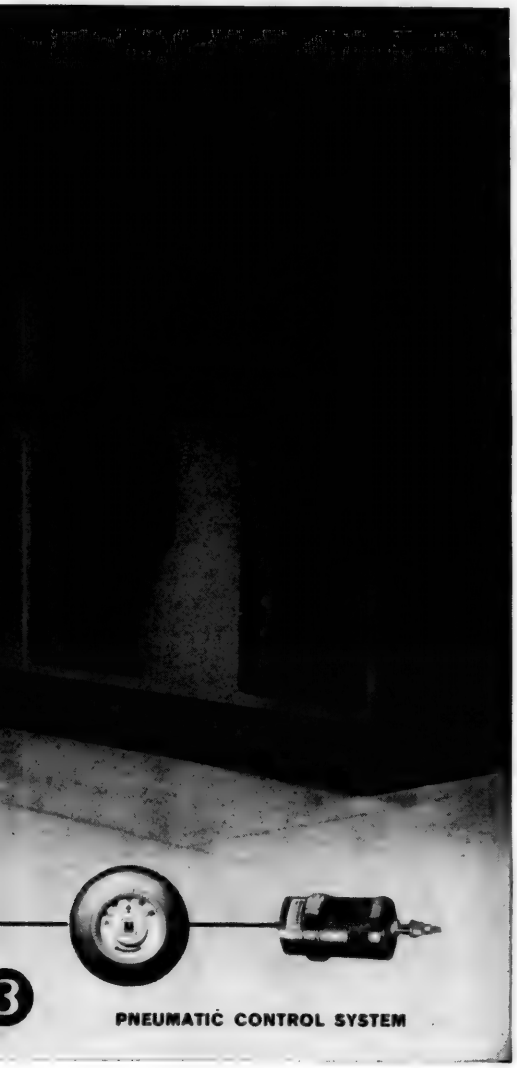


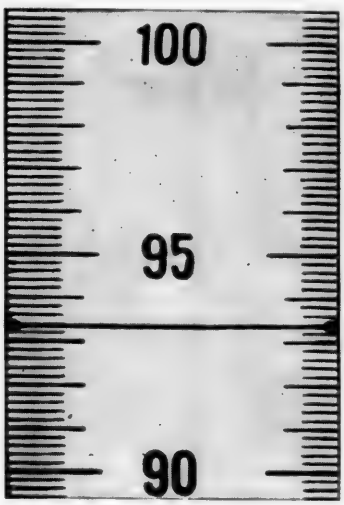
utomatic Air Dryer—An exclusive from Honeywell! xtracts all damaging moisture from the compressed air the pneumatic control system. Requires virtually no Two fully automatic drying tanks work interchangeably.

lter—Highly efficient new filter removes all dirt and oil pressure air. Has a transparent housing and a replace-ement, so you can check visually to see when it needs

ressure Reducing Valve Station—Maintains control air at the precise pressure regardless of the drain n. Built-in safety pressure relief valve can be adjusted d safe operating pressure of the downstream line. PRV automatically bleed off the pressure difference when n one pressure system to another.

Check your fan system's temperatures accurately—with

HONEYWELL'S ELECTRONIC INDICATOR



Scale shown full size. Twin hairline index prevents parallax errors.

Compact chassis only 6½" wide. Slides out for inspection without stopping operation of indicator.

With this new, compact indicator, the operating engineer can remotely read temperatures at any point in a central fan system simply by pressing a button. And he gets the most accurate readings used in air conditioning. Honeywell's indicator can be read to plus or minus 1/5 of a degree.

Central fan system temperatures can all be checked instantly on this one instrument in less than a square foot of panel space. Sensing elements are connected to the indicator by low voltage wiring.

At little extra cost, a Honeywell Systems Analyzer can be added when desired. Using the same wiring and sensing elements as the indicator, it records, on a 12-inch wide strip chart, the readings for any points or combination of points providing a permanent record.

NEW LITERATURE

Use the prepaid postcard on last page for securing your copies of these catalogs.

Zone Heat Control

Zonvalve, called a modern zone heat control for steam, hot water, and chilled water systems, is described in 4-page bulletin published by Heat-Timer Corp., New York, N. Y. Bulletin gives construction features, dimensions, and wiring and typical installation diagrams.

Circle **Item 51** on Inquiry Card

Electronic Air Cleaner

A 16-page product bulletin which describes the Model B Rollotron electronic air cleaner is announced by American Air Filter Co., Inc., Louisville, Ky. Included are details of operation, equipment drawings, capacity and dimension tables, specifications, and typical installations.

Circle **Item 52** on Inquiry Card

Installation Guides

Bell & Gossett Co., Morton Grove, Ill., offers two new installation guides. The booklets, one for package liquid coolers (SD-704-CA) and the other for condensing units and motor compressors (SD-714-CA), contain all essential data needed for installing this equipment.

Circle **Item 53** on Inquiry Card

Valves for Heating, Air Conditioning

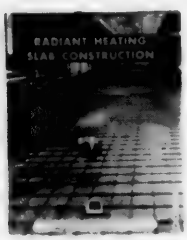
Bronze and iron body gate, globe and check valves for heating and air conditioning systems are illustrated and described in Bulletin No. V-6, published by The Fairbanks Co., New York, N. Y. Each description includes application, basic design features and standard sizes.

Circle **Item 54** on Inquiry Card

Packaged Firetube Boilers

A discussion of packaged firetube boilers—from construction features to final test and start-up service—is presented in a 12-page brochure published by Cleaver-Brooks Co., Milwaukee, Wis. Bulletin covers boilers through 600 hp for heating and processing, steam or hot water.

Circle **Item 55** on Inquiry Card



Radiant Heating Slab Construction

A new edition of the 8-page report, Radiant Heating Slab Construction, is offered by A. M. Byers Co., Pittsburgh, Pa. Included are sketches of various types of radiant heating slab construction, in preferred order, plus a digest of construction recommendations.

Circle **Item 56** on Inquiry Card

Silent Refrigerant Condenser

A 16-page manual describing the company's silent refrigerant condenser is offered by Edwards Engineering Corp., Pompton Plains, N. J. Manual includes a detailed explanation of Airvec's operating principle, specific operating advantages, installation instructions and other data.

Circle **Item 57** on Inquiry Card

Underground Pipe Insulation

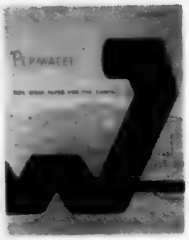
Information on three customized systems of underground pipe insulation is available from Concrete Thermal Casings, Inc., Seattle, Wash. Brochure describes "CTC," "Z-Crete," and "b-t-u" systems, and the qualities that make one of these systems just right for any job requirements.

Circle **Item 58** on Inquiry Card

Vertical Turbine-Type Pumps

Short-coupled, vertical turbine-type pumps for a wide range of applications are described in Bulletin 08B-9409, published by Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Four-page bulletin describes applications, parts and performance of the pumps in 40 sizes to 8000 gpm.

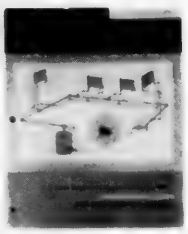
Circle **Item 59** on Inquiry Card



Pipe Wrap Tapes

Permacel, New Brunswick, N. J., makes available a 6-page brochure describing its various types of pipe wrap tapes for the control of corrosion. A comprehensive chart of pipe wrap coverage data and specifications for use of the tapes are also included in the informative bulletin.

Circle **Item 60** on Inquiry Card



Condensation Pumps

Condensation pumps for steam heating systems are described in a 6-page catalog offered by Pump Div., C. H. Wheeler Manufacturing Co., Philadelphia, Pa. Installation diagrams are shown; ratings, capacities, pressures and speeds are given for six different types of condensation pumps.

Circle **Item 61** on Inquiry Card

Air Dehumidifier

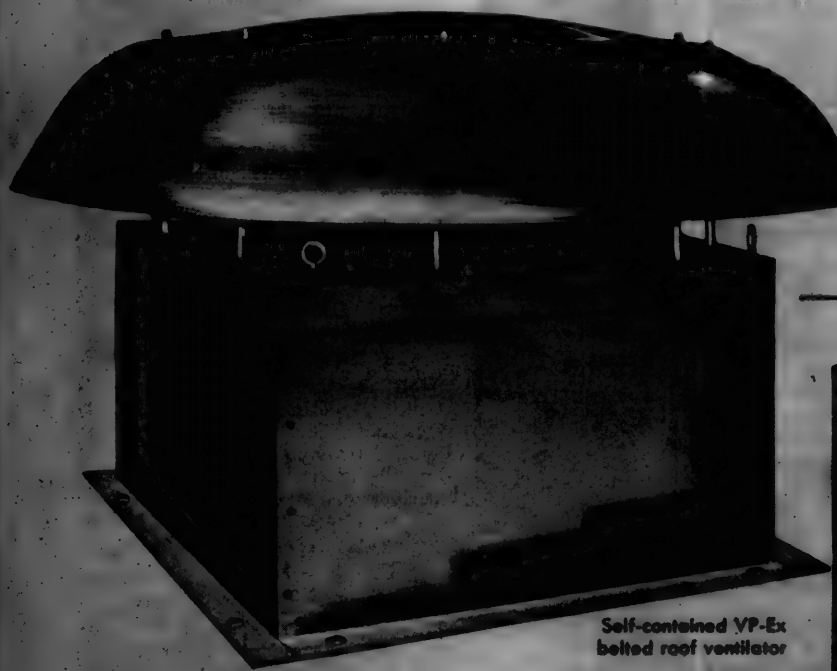
Niagara Blower Co., New York, N. Y., announces Bulletin No. 140 describing the Hygrol air dehumidifier. This apparatus uses a liquid absorbent for drying air to control its properties for industrial processing, product drying, and space conditioning. Chart of dehumidifying capacities included.

Circle **Item 62** on Inquiry Card

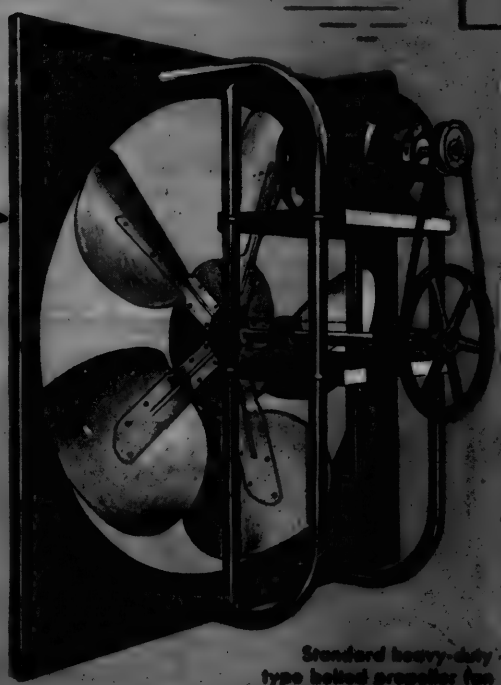
(New Literature continued on page 126)

VP-EX PROPELLER-TYPE

belted roof ventilator



Self-contained VP-Ex belted roof ventilator



Standard heavy-duty type belted propeller fan

The outstanding performance of the VP-Ex Belted Roof Ventilator is derived from insistence on quality at every step—from its galvanized construction through its complete industrial-type propeller fan. This large-capacity workhorse keeps overall height at a minimum while providing efficient operation and proper clearance between air discharge and roof. Capacities from 4450 CFM to 33900 CFM; also available in smaller direct drive sizes.

Send for Bulletin 582.

nyb

THE NEW YORK BLOWER COMPANY

SALES OFFICES: 3147 SOUTH SHIELDS AVENUE • CHICAGO 16

Quickdraft... THE WORLD'S SAFEST

POWER DRAFT UNIT FOR INDUSTRIAL, RESIDENTIAL AND INSTITUTIONAL EXHAUSTING

Increases heating and combustion efficiency!

Provides air power for bulk materials handling!

Exhausts corrosive gases and abrasives!

Quickdraft provides industry, commerce, institutions and homebuilders *power draft* engineered for economical and efficient combustion regardless of building or atmospheric conditions. Models suitable for every heating or incinerator application . . . eliminate pulsating or chattering, puffing, smoking and sooting. Reduce building costs, no tall, unsightly stacks required. Quickdraft also provides industry with ¼ inch to 60 inches W.G. static pressure for exhausting corrosive gases, abrasives and paint spray. Heavy-duty, high-pressure models, 6 inches to 30 inches diameter, are available for moving bulk materials or anything that can be moved by air. Because there are no motors, fans or bearings in exhaust line, only Quickdraft avoids costly clogging, corrosion of moving parts or fan failure.

IMPORTANT NOTICE

For withstanding corrosive gases, all Quickdraft units are available in standard acid resisting vitreous enamel, No. 316 Stainless Steel, rigid plastics (P.V.C.) and with plastic and Fiberglas coatings.

N-622-QD

NO MOTORS FANS OR BEARINGS IN EXHAUST LINE

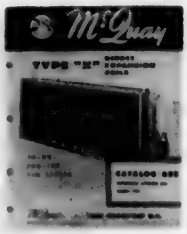
Send for QUICKDRAFT ENGINEERING DATA on your application . . . now.

Quickdraft CORPORATION

P.O. Box 87—O Canton 1, Ohio

(Continued from page 124)

Use the prepaid postcard on last page for securing your copies of these catalogs.



Direct Expansion Coils

A 40-page catalog describing Type "X" direct expansion coils is published by McQuay, Inc., Minneapolis, Minn. More than half of Catalog No. 405 is devoted to detailed temperature and altitude conversions, rating tables, and psychrometric tables and charts for quick, direct coil selection.

Circle **Item 63** on Inquiry Card

Air Filtration

Flanders Filters, Inc., Riverhead, N. Y., announces a 48-page filtration catalog. Following an introduction covering the general subject of air filtration, catalog presents product information and selection data on the company's Airpure absolute filters and Expandure filters.

Circle **Item 64** on Inquiry Card

Sheet Metal Products

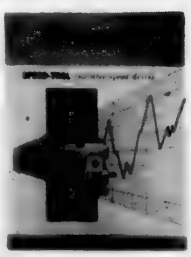
Inland Steel Products Co., Milwaukee, Wis., announces a 64-page pocket-size catalog, No. 300-a, on Milcor sheet metal products. Contents include product and installation data for roof drainage products, building specialties, ventilators, and heating and air conditioning products.

Circle **Item 65** on Inquiry Card

Light Weight Welding Fittings

Savings obtainable by using light weight carbon steel piping are outlined in Bulletin TT-942, entitled Fittings and Flanges for Light Weight Piping, available from Tube Turns Div., Chemetron Corp., Louisville, Ky. Specifications are given for elbows, tees, caps, reducers, and flanges.

Circle **Item 66** on Inquiry Card



Variable-Speed Drives

Sterling Electric Motors, Inc., Los Angeles, Calif., announces 8-page bulletin No. 195 covering its Speed-Trol variable-speed drives. Bulletin illustrates and describes the basic types of variable-speed drives, plus a variety of modifications, and includes suggested applications.

Circle **Item 67** on Inquiry Card

Packaged Air Conditioners

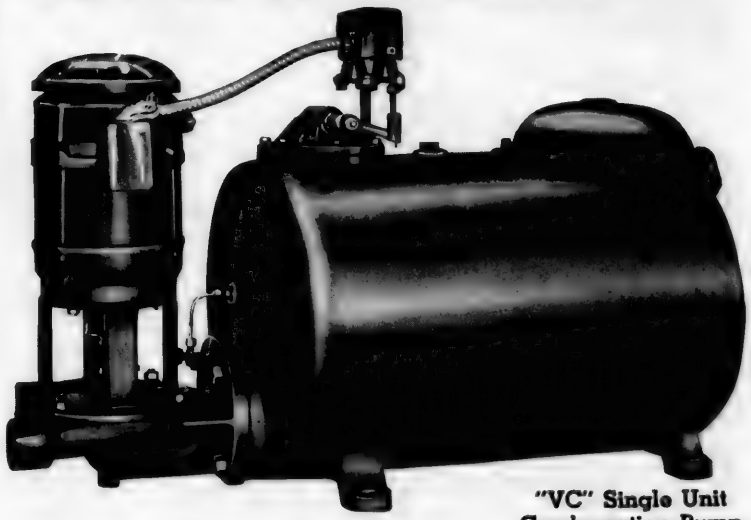
An 8-page brochure (Bulletin 8525) describing the American-Standard line of packaged air conditioners is available from American-Standard Industrial Division, Detroit, Mich. Capacities and physical data are presented in tabular form, covering both air-cooled and water-cooled designs.

Circle **Item 68** on Inquiry Card

(Continued on page 128)

Specify SKIDMORE

FOR PUMP PERFORMANCE
NOT PUMP PROMISES



"VC" Single Unit
Condensation Pump

TWO OUTSTANDING SKIDMORE PUMPS THAT HAVE STOOD THE PERFORMANCE TEST!

1 Easily Accessible • • • • • • Compactly Designed

2 Close-Coupled • • • • • • Mechanical Shaft-Sealed

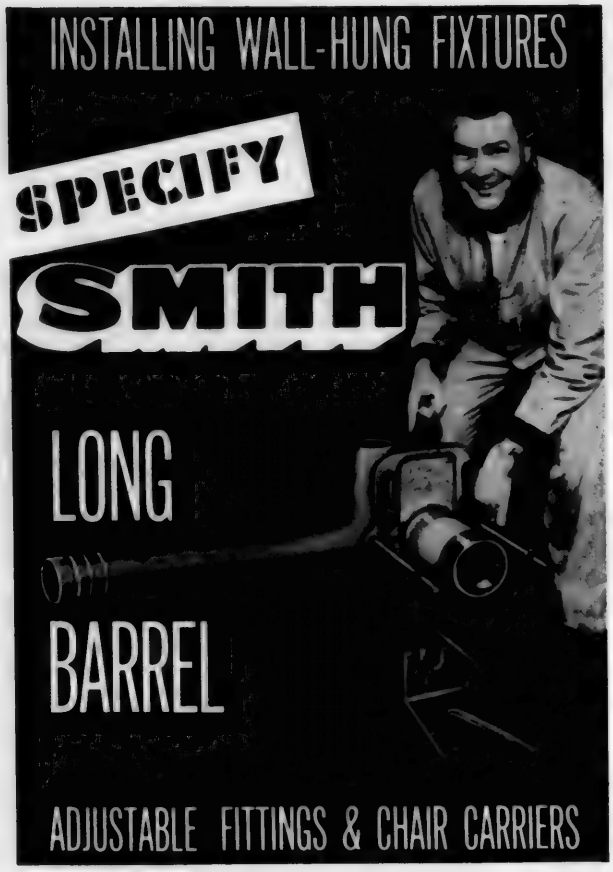
"CCVS" Single Unit
Vertical Pump

There's a Skidmore Pump designed for each and every heating requirement.
Write for Bulletins

SKIDMORE PUMPS

SPECIFY WITH CONFIDENCE

SKIDMORE CORPORATION ST. JOSEPH, MICHIGAN



Make the Job
PLUMB-EASY

CUT COST
SAVE TIME, LABOR, MATERIAL

On horizontal battery runs, the new Jay R. Smith Caulked Long Barrel Fittings make Wall-Hung Fixture installations "PLUMB-EASY."

Providing an extra long spigot, Long Barrel Fittings permit caulked carrier fittings to be installed on 36" (or less) centers without requiring additional piping, and eliminating the caulking of extra joints.

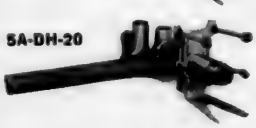
Saving time, labor, and material, Smith Long Barrel Fittings cut cost and make a stronger, neater installation.

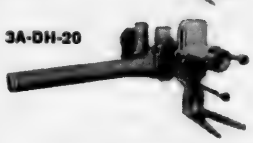
Long Barrel Fittings are furnished with cut-off rings to permit setting on centers from 30" to 36".

Caulking into each other, Long Barrel Fittings form a continuous horizontal drainage line.

5A-HR 20

3A-HR-20


5A-DH-20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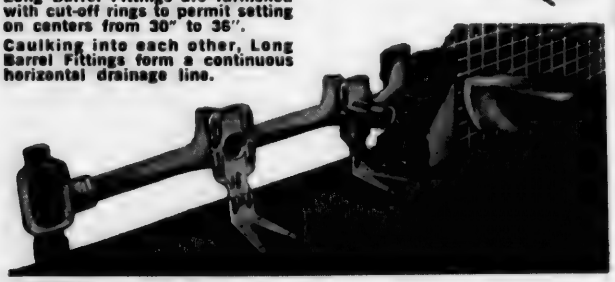


JAY R. SMITH MFG. CO. Union, New Jersey PLUMB-EASY

CHAIR CARRIERS

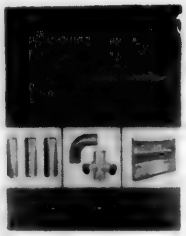
DRAINS

INTERCEPTORS

New Literature

(Continued from page 126)

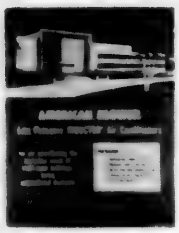
Use the prepaid postcard on last page for securing your copies of these catalogs.



Sheet Metal Specialties

A 12-page catalog, No. 35-8, of sheet metal specialties serving a wide variety of applications is announced by Carrier Corp., Syracuse, N. Y. Brochure provides detailed information on round metal ducts, called Spira-Pipe; also die-formed elbows and flexible quick-connectors.

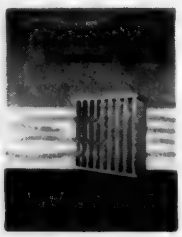
Circle **Item 69** on Inquiry Card



Induction Air Conditioners

An 8-page brochure (Bulletin 9127) describing the improved line of American Blower low-pressure Inductor air conditioners for perimeter air conditioning of multi-room buildings is available from American-Standard Industrial Division, Detroit, Mich. Selection data are included.

Circle **Item 70** on Inquiry Card



Charcoal Filters

The use of activated charcoal filters as part of a two-stage air cleaning system is the subject of a 4-page bulletin published by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. Action of activated charcoal is explained; company's charcoal filter cells are described.

Circle **Item 71** on Inquiry Card

Shorter, Lighter Motors

General Electric Co., Schenectady, N. Y., offers 8-page bulletin, GEA-6927, describing company's Thinline motor, rated from 1 to 5 hp in drip-proof and totally enclosed constructions for limited space applications. Bulletin includes product features, interchangeable flange dimensions.

Circle **Item 72** on Inquiry Card

Wall-to-Wall Convectors

Bulletin 259-A, offered by Modine Manufacturing Co., Racine, Wis., gives descriptive and engineering information on company's line of Perma-Trim wall-to-wall convectors. It includes sizes, specifications, and complete selection data for face outlet and sloping-top outlet types.

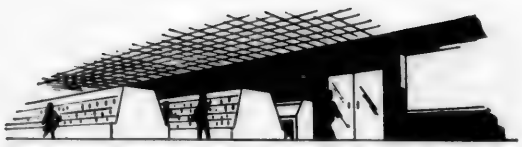
Circle **Item 73** on Inquiry Card

Automatic Controls

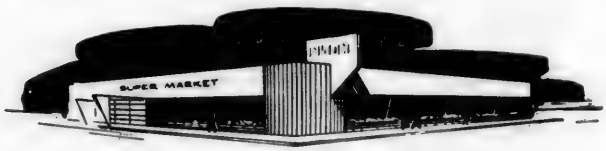
A 24-page catalog of automatic controls for refrigeration and air conditioning applications is available from Penn Controls, Inc., Goshen, Ind. New listings in Bulletin 1487-AK include line voltage heating and cooling thermostats which supplement several previously cataloged thermostats.

Circle **Item 74** on Inquiry Card

(Continued on page 130)



INSTALL IT INDOORS



INSTALL IT OUTDOORS

The McQuay "AL" AIRCON air cooled condenser provides the ultimate in flexibility by combining refrigerant condensing with heating and ventilating. You can utilize condenser heat for heating, and this AIRCON may also be used for exhaust ventilation, saving both time and money in installation, maintenance and operating costs.

"AL" AIRCON is compactly designed, and because of a very low silhouette, will not detract from the appearance of a building when roof mounted . . . the largest model is less than 4½ feet high, unnoticeable from the street.

"AL" AIRCON condensers are available in 8 different fan discharge arrangements and in 16 different unit arrangements . . . all standard. Each condenser coil is factory circuited in single or multiple sections to meet specific requirements of either air conditioning or refrigeration applications. Contact your nearest McQuay representative, or write McQuay, Inc., 1619 Broadway Street N. E., Minneapolis 13, Minnesota.

utilize condenser heat with this low silhouette blower type

AIR COOLED AIRCON

McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

(Continued from page 128)

Use the prepaid postcard on last page for securing your copies of these catalogs.

Prefabricated Insulated Pipe

Offered by Durant Insulated Pipe Co., Palo Alto, Calif., is Catalog No. 36 describing the company's prefabricated, insulated and waterproofed pipe and fittings for underground and overhead weather-exposed locations. Manual contains heat transfer data, installation instructions.

Circle **Item 75** on Inquiry Card

Systems of Air Conditioning

Various systems of air conditioning which Frick Company, Waynesboro, Pa., has installed in office buildings, hospitals, hotels, stores, and industrial plants are described in 20-page Bulletin No. 505-E. Bulletin then discusses and evaluates the various systems.

Circle **Item 76** on Inquiry Card

Plumbing Fixture Fittings

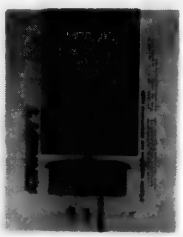
A 16-page catalog, S-99, containing technical data, flow rate charts and illustrated features of the new Autoflo line of showers and plumbing fixture fittings is offered by Speakman Company, Wilmington, Del. Line incorporates company's quiet-operating automatic flow control.

Circle **Item 77** on Inquiry Card

Air Mover

Available is a 12-page bulletin describing the Wausau air mover manufactured by Greenheck Fan & Ventilator Corp., Schofield, Wis. For both direct-drive and belt-drive types, the bulletin lists specifications, dimensions, performance data, and construction features.

Circle **Item 78** on Inquiry Card



Fire Hydrants

An 8-page bulletin, No. 591, describes a new line of fire hydrants manufactured by Kennedy Valve Mfg. Co., Elmira, N. Y. Hydrants have a minimum number of parts; in addition, all working parts can be easily removed for maintenance without excavation.

Circle **Item 79** on Inquiry Card

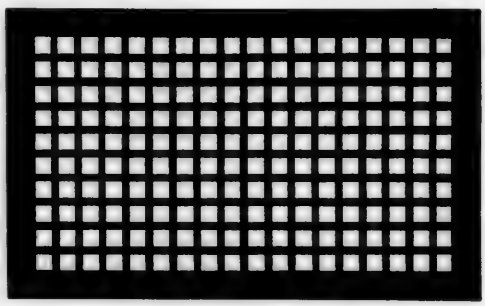
Continuous Boiler Blowoff

Savings in both labor and operating costs through the use of continuous boiler blowoff systems can yield a higher return on equipment cost than almost any other type of plant investment, according to a bulletin published by Cochrane Corp., Philadelphia, Pa.

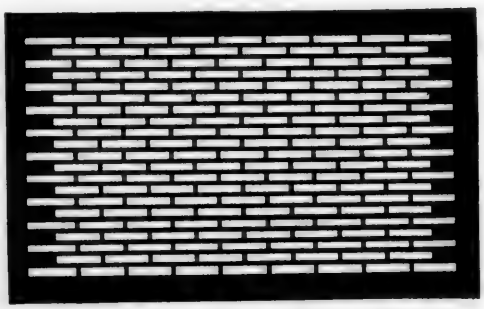
Circle **Item 80** on Inquiry Card

A-J

Architectural Grilles for every type of installation

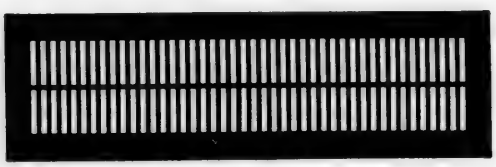


LATTICE PATTERN — ¾" Square
57% Free Area



DESIGN C — 73% Free Area

Getting exactly what you want is no problem when you specify A-J Architectural Grilles. There are practically no limitations on size and grilles can be made to your exact order from steel, aluminum, bronze, monel or stainless. Available in slotted designs B, C, and D, and square meshes of ½", ⅝", ¾" and ⅞".



NEW FROM A-J! Design E Convector-type grille with vertical pencil-proof slots for cooling or heating outlets, return or exhaust application. Free area 54%. May be installed in sills, sidewalls, ceilings or floors. Available in steel, aluminum, stainless or bronze.

Send for FREE A-J catalog that contains complete specifications.

A-J MANUFACTURING CO.

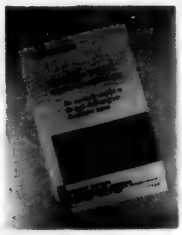
Dept. V-9 3601 E. 18th St. Kansas City 27, Mo.

Use the prepaid postcard on last page for securing your copies of these catalogs.

Expansion Joints

A 6-page bulletin on Badger S-R expansion joints is available from Expansion Joint Div., Badger Manufacturing Co., Cambridge, Mass. Illustrated bulletin contains selection data; general information on flanges, liners, covers, and temperature ratings; and list of service representatives.

Circle **Item 81** on Inquiry Card



Low Velocity Air Diffusers

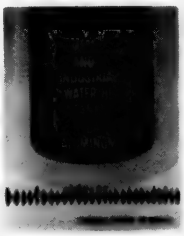
What low velocity air diffusion can mean to the ventilating engineer, building management, and tenants is told in an 8-page folder available from Multi-Vent Div., The Pyle-National Co., Chicago, Ill. Folder describes company's five basic types of diffusers and gives technical data.

Circle **Item 82** on Inquiry Card

Vertical Discharge Heaters

How to effectively heat space in buildings with high ceilings is described in 16-page Catalog 2659, published by Young Radiator Co., Racine, Wis. Includes technical data, mounting heights, spread circle diameters, unit capacities of 30 sizes, specifications and dimensional drawings.

Circle **Item 83** on Inquiry Card



Aluminum Alloy Water Heaters

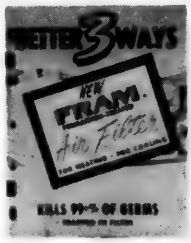
Aluminum's ability to transfer heat rapidly and effectively resist corrosion is gaining a new market for the light metal in commercial and industrial hot water heaters, reports Aluminum Company of America, Pittsburgh, Pa. Brochure describes Ruud-Alcoa heaters, gives selection data.

Circle **Item 84** on Inquiry Card

Water Conditioners

A line of commercial and light industrial water conditioning units that provide completely automatic soft-conditioned water for the same price as manual units is announced by Water Refining Co., Middletown, Ohio. Equipment is illustrated, with specifications, in 4-page bulletin.

Circle **Item 85** on Inquiry Card



Germicidal Air Filters

An 8-page bulletin, from Fram Corp., Providence, R. I., describes the company's line of Permachem-treated air filters. These filters are said to remove 90 to 98% of all germs reaching the filter, and to kill more than 99% of these; bulletin gives the complete story.

Circle **Item 86** on Inquiry Card

The complete quality line

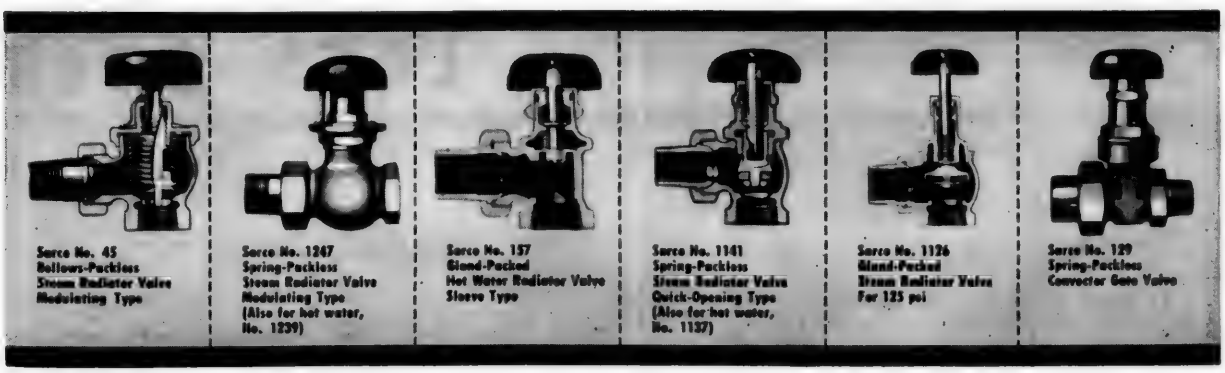
SARCO RADIATOR VALVES

for steam and hot water

Here's one reliable specification for all radiator valve requirements: Sarco.

For steam, Sarco makes the Bellows-Packless, Spring-Packless and Gland-Packed types. For hot water: Spring-Packless and Gland-Packed types. These are supplied in globe, angle and corner patterns; gate type; modulating and quick-opening models. For pressures up to 200 psi.

Write for Bulletins.



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BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

INDUSTRIAL BUILDING DETAILS

Over 1,500 architectural details for contemporary industrial buildings are presented by Duane F. Roycraft, architect, in Industrial Building Details, a practical reference book.

Details which the author believes to be useful, time-saving and universal in application are included. Structural details cover walls, windows, louvers, roofs, parapets, monitors, floors, ventilators, expansion joints, flashing, canopies, doors, door frames, stairs, ladders, platforms hatch covers, manholes, and storage and transport facilities.

Industrial Building Details, D. F. Roycraft. Cloth binding, 8¾ x 11⅝ inches, 356 pages. Published by F. W. Dodge Corp., 119 W. 40 St., New York 18, N. Y. Price, $12.75.

• • •

ARC WELDED JOINTS—The Arc Welding Section of the National Electric Manufacturers Association has published a 46-page booklet on Strength of Arc Welded Joints. It is intended to supplement the general textbooks on elementary strength of materials that are used for undergraduate study in engineering colleges. National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y.

LEAKAGE FROM UNDERGROUND FLAMMABLE LIQUID TANK—A new guide dealing with underground tank leakage, pertaining to flammable liquids, has been issued by the National Fire Protection Association. It covers installation, leak detection and protection of contaminated areas. National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. Price, 50 cents.

PLASTIC PIPE—A recorded voluntary standard regarding flexible polyethylene plastic pipe published by the U. S. Department of Commerce. It covers requirements for material, workmanship, dimensions, pressures, pipe thickness and cracking. It is listed as CS 197-59 and is for sale by Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, ten cents.

INSTALLATION OF OIL BURNING EQUIPMENT—Fire safety requirement standards for the installation of oil burning equipment are covered in the 1959 edition of NFOA No. 31. It incorporates 24 changes revising and clarifying the previous edition. National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. Price, 60 cents.

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MORE BENEFITS

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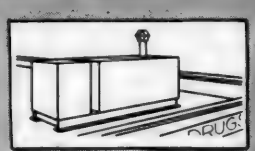
Ventil-Aire Units are quality constructed to provide years of dependable, trouble-free service. Available in 5, 7½ and 15 ton sizes. *Write for detail specifications and facts.*



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C/S DOOR LOUVERS

superb quality
rugged construction
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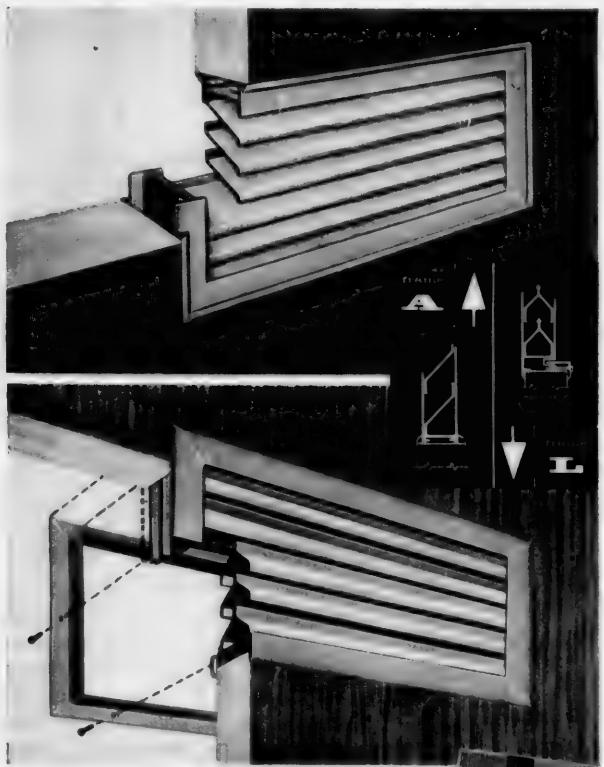
This new C/S Louver is a precision engineered product that is neat, attractive, and practical. It is competitive with sheet metal assemblies yet has many attractive qualities available only in extrusions. C/S mass production facilities make possible off-the-shelf shipment and stock item pricing.

Two blade styles and two frame sizes simplify door louver selection. The A Frame louver uses traditional wood molding. The L Frame louver is supplied with a matching extruded interior trim frame that quickly and securely clamps the louver in the door opening.

Five louver types are available: sight-proof, light proof, vertical line, sound absorbent, and standard. They are available in mill finish aluminum, etch and clear lacquer, anodized or prime coat for field painting.



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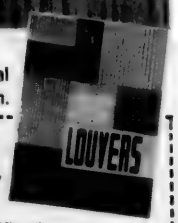
— Complete specifications, stock sizes, technical information, and typical installation illustration.



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☐ literature ☐ specifications
☐ name of local representative so that we may inspect product sample

name_____

firm_____ title_____

address_____

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available

INDUSTRIAL GAS SCHOOL—Industrial gas school of the American Gas Association, Penn-Sheraton Hotel, Pittsburgh, Pa. Relbern H. Murray, American Gas Association, 420 Lexington Ave., New York 17, N. Y. ..... **SEPTEMBER 14-18, 1959.**

MANAGEMENT CONFERENCE—Engineering management conference sponsored by ASME and AIEE at the Statler-Hilton Hotel, Los Angeles, Calif. ASME secretary, O. B. Schier II, 29 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 17-18, 1959.**

PETROLEUM CONFERENCE—Petroleum Mechanical Engineering Conference at Rice Hotel, Houston, Tex. ASME secretary, O. B. Schier II, 29 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 20-23, 1959.**

ISA INSTRUMENT-AUTOMATION EXHIBIT—14th annual Instrument-Automation Conference and Exhibit of the Instrument Society of America, at the International Amphitheatre, Chicago, Ill. H. S. Kindler, ISA, 313 Sixth Ave., Pittsburgh 22, Pa. ..... **SEPTEMBER 21-25, 1959.**

POWER CONFERENCE—National Power Conference sponsored by ASME and AIEE at the Hotel Muehlebach, Kansas City, Mo. ASME secretary, O. B. Schier II, 29 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 27-OCTOBER 1, 1959.**

WELDING SOCIETY MEETING—Fall meeting of the American Welding Society, at the Sheraton-Cadillac Hotel, Detroit, Mich. A. L. Phillips, American Welding Society, 33 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 28-OCTOBER 1, 1959.**

AGA CONVENTION—Annual convention of the American Gas Association, at the Conrad-Hilton Hotel, Chicago, Ill. C. S. Stackpole, managing director of the Association, 420 Lexington Ave., New York 17, N. Y. ..... **OCTOBER 5-7, 1959.**

ASA CONFERENCE—10th National conference on Standards, at the Sheraton-Cadillac Hotel, Detroit, Mich. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. ..... **OCTOBER 20-22, 1959.**

FUELS CONFERENCE—Fuels Conference sponsored by ASME and AIME at Netherland Hilton Hotel, Cincinnati, Ohio. ASME secretary, O. B. Schier II, 29 W. 39th St., New York 18, N. Y. ..... **OCTOBER 26-29, 1959.**

REFRIGERATION SERVICE ENGINEERS CONVENTION—Convention of the Refrigeration Service Engineers Society, at the Ambassador Hotel, Atlantic City, N. J. Secretary of the Society, 433 No. Waller Ave., Chicago, Ill. ..... **OCTOBER 30-NOVEMBER 2, 1959.**

AIR CONDITIONING WHOLESALERS MEETING—Annual meeting of the Air-Conditioning and Refrigeration Wholesalers, in Atlantic City, N. J. Secretary, 2607 N. High St., Columbus, Ohio. ..... **NOVEMBER 1-2, 1959.**

ARI EXPOSITION—11th Exposition of the Air-Conditioning and Refrigeration Industry at Convention Hall, Atlantic City, N. J. Geo. S. Jones, Jr., managing director of Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C. ..... **NOVEMBER 2-5, 1959.**

METAL EXPOSITION & CONGRESS—41st National Metal Exposition & Congress, sponsored by the American Society for Metals, at the International Amphitheatre, Chicago, Ill. Seward Covert & Associates, 1059 Leader Bldg., Cleveland 14, Ohio. ..... **NOVEMBER 2-6, 1959.**

HOTEL EXPOSITION—National Hotel Exposition, New York Coliseum, New York, N. Y. ..... **NOVEMBER 2-6, 1959.**

(Concluded on page 136)

Here's the LOW COST Answer to the Hot Water Problem for Coin-operated Laundries, Restaurants, Motels, Schools, Clinics, Apartments, Small Plants

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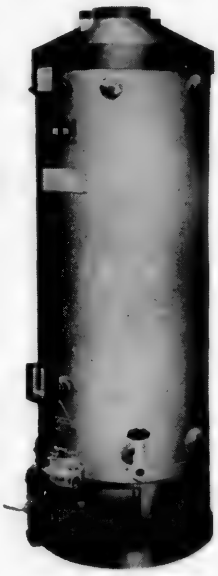

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Provides a constant, plentiful supply of 180 degree HOT WATER! Automatic TROUBLE-FREE operation! Compact! . . . Quickly and easily installed . . and ABSOLUTELY SAFE! Amazingly efficient and economical. Ask a Ewing user what he thinks of his Ewing heater.

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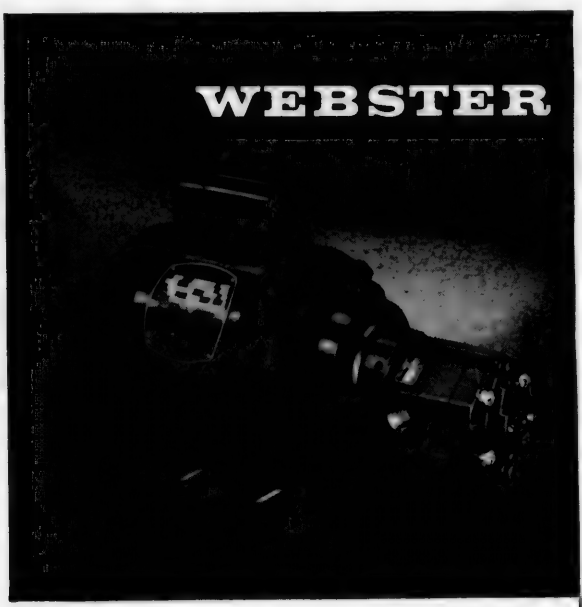

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Capacities to 575 GPH

This is the way to handle all furnace oils, especially heavy no. 5 and 6 grades — with an extra measure of dependability required for commercial and industrial applications. Webster supply pumps are motor equipped, provide a range of capacities from 15 GPH to 575 GPH. Heavy oil models have extra large ports to transfer initially cold, heavy oils without restriction.

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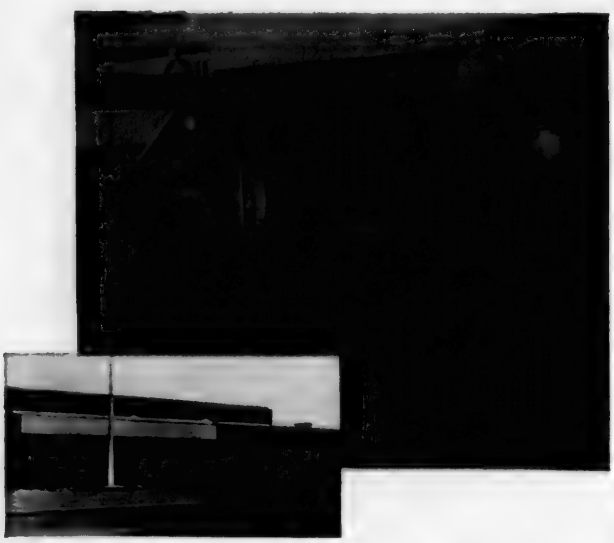
Cyclotherm meets all state requirements, conforms to A.S.M.E. and National Board standards, carries Underwriters' Laboratories label. Burns oil and/or gas. Steam generators: 15 to 750 HP. Hot water Generators: 670,000 to 6,700,000 BTU per hr.



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Please send me full information about Cyclotherm Steam and Hot Water Generators.

(Concluded from page 134)

CONTROL CONFERENCE—National Automatic Control Conference, sponsored by ASME, IRE, AIEE, ISA, Sheraton Hotel, Dallas, Tex. ASME Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **NOVEMBER 4-6, 1959.**

CEC SEMI-ANNUAL MEETING—Consulting Engineers Council, Board of Directors semi-annual meeting, Cincinnati, Ohio (hotel to be selected). Executive Secretary, L. N. Spiller, 326 Reisch Building, Springfield, Ill. ..... **NOVEMBER 4-7, 1959.**

COMMERCIAL KITCHEN PLANNING—Seminar on commercial kitchen planning at Michigan State University, East Lansing, Mich. Ralbern H. Murray, American Gas Association, 420 Lexington Ave., New York 17, N. Y. ..... **NOVEMBER 9-13, 1959.**

BRI FALL CONFERENCE—Building Research Institute Fall Conference at Shoreham Hotel, Washington, D. C. Program on November 17 devoted to new heating techniques. Harold Horowitz, Assistant Director for Technical Programs, Building Research Institute, 2101 Constitution Ave., Washington 25, D. C. ..... **NOVEMBER 16-19, 1959.**

ASME ANNUAL MEETING—Annual meeting of the American Society of Mechanical Engineers, Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **NOVEMBER 29-DECEMBER 4, 1959.**

WARM AIR HEATING CONVENTION—Annual convention of the National Warm Air Heating and Air Conditioning Association, at the Chase Hotel, St. Louis, Mo. G. Boeddener, managing director of the Association, 640 Engineers Bldg., Cleveland 14, Ohio. ..... **DECEMBER 1-4, 1959.**

ASHRAE MEETING—Semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, and the 2nd Southwest Heating and Air-Conditioning Exposition, sponsored by ASHRAE, in Dallas, Tex. The meeting will be at the Baker and Adolphus Hotels, and the Exposition in the Memorial Auditorium. Secretary of the Society, 62 Worth St., New York 13, N. Y. ..... **FEBRUARY 1-4, 1960.**

ISA INSTRUMENT-AUTOMATION EXHIBIT—ISA Instrument-Automation Conference and Exhibit, at the Houston Coliseum, Houston, Tex. W. H. Kushnick, executive director, Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa. ..... **FEBRUARY 1-5, 1960.**

FIRST NATIONAL ELECTRIC HOUSE HEATING EXPOSITION, sponsored by the National Electrical Manufacturers Association, at the Sherman Hotel, Chicago. R. D. Smith, secretary of the Association, 155 East 44th St., N. Y. 17, N. Y. .... **MARCH 21-23, 1960.**

GAMA MEETING—Annual Meeting of the Gas Appliance Manufacturers Association, at The Greenbrier, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. ..... **MARCH 30-APRIL 1, 1960.**

OHI EXPOSITION AND CONVENTION—23rd National Oil Heat and Air Conditioning Exposition, at the New York Coliseum, held concurrently with the 28th annual convention of OHI, at the Park-Sheraton Hotel, New York City. Secretary, Oil Heat Institute of America, Inc., 500 Fifth Ave., New York 36, N. Y. ..... **APRIL 4-7, 1960.**

WELDING SOCIETY MEETING—41st annual Meeting and Welding Exposition of the American Welding Society in Los Angeles Calif. Headquarters to be announced later. A. L. Phillips, secretary of the Society, 33 W. 39th St., New York 18, N. Y. ..... **APRIL 25-29, 1960**

WESTERN EXPOSITION—Third Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference, Shrine Exposition Hall, Los Angeles, Calif. F. J. Tabery, exhibit manager, 3443 S. Hill St., Los Angeles 7, Calif. Exhibit sponsored by Western Air Conditioning Industries Association. ..... **APRIL 27-30, 1960.**

METAL EXPOSITION & CONGRESS—2nd Southwestern Metal Exposition & Congress, at State Fair Park, Automobile Building, Dallas, Tex. C. L. Wells, exposition manager, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. .... **MAY 9-13, 1960.**

CONGRESS ON OCCUPATIONAL HEALTH—13th International Congress on Occupational Health, first to be held in the Western Hemisphere, at the Waldorf Astoria Hotel, New York City. Dr. Leo Wade, organizing committee, 15 W. 51st St., New York 19, N. Y. ..... **JULY 25-29, 1960.**

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No filter does all jobs, meets every need. That's why Airsan Filters are engineered to the job to offer more effective dust collection. Airsan's expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing. It distributes air easily over the entire filter area. Provide high filtering efficiency and dust holding capacity with less resistance. Features include all galvanized construction and welded lock corners. Write for data.

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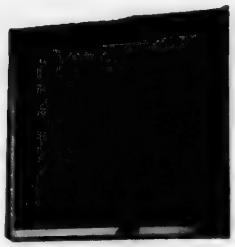
Viscous type, permanent and cleanable designed for industrial, commercial and domestic use. Available in 1" and 2" thickness.



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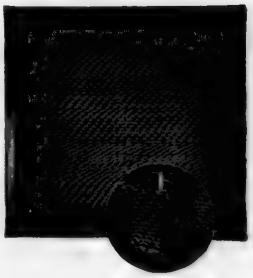
(High Velocity)

Has a specially designed high velocity Viro-Crimp filter core. Hemmed edges provide a safety feature. Operates efficiently at 300 to 500 fpm. Available in 2" and 4" thickness.



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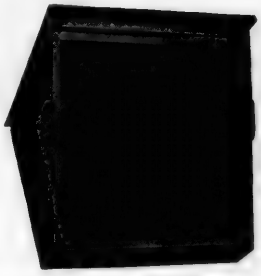
Permanent, cleanable type Airsan Grease Filters made especially for range canopies, galleys, kitchens. Available in 2" thickness.



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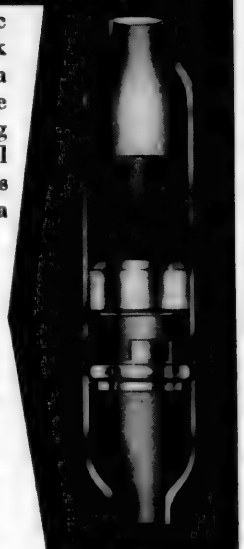
A SPUN END CHECK VALVE AND STRAINER COMBINATION

Magni-Chek is a non-electric magnetically operated check valve, so finely calibrated that a fraction of an ounce of pressure will open the passage permitting a smooth flow without the usual pressure drop. Since no springs are used back pressure is at a minimum.



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- Built-in Monel Strainer
- Lifetime Alnico Magnet
- Maximum Flow
- Minimum Back Pressure
- Not Affected By Soldering Heat

This valve is also available without the strainer, and both types are stocked in the following sizes: 1/4", 5/16", 3/8", 1/2", 5/8" and 3/4". Special size inlet and outlet connections can be made to your specifications.

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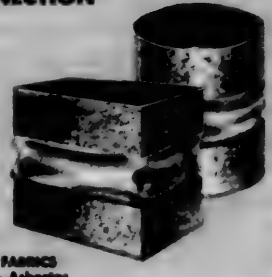
A PREFABRICATED FLEXIBLE DUCT CONNECTION

Simply pull out desired length from dispenser-type carton. (It pulls out ready to use.) Roll into round duct or form into square duct and join. Saves 70% time over old methods. DOUBLE-SAFE-LOCKED



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THE MARK OF QUALITY

BARBER COLMAN

Automatic Controls

Accurate eye-level remote temperature indication

. . . no limit to the number of points monitored by a single instrument

Temperatures anywhere in a building can be read on a single, centrally located Barber-Colman indicator wired to remotely located sensing elements. Time-consuming trips to check temperatures at remote points are eliminated completely.

The system is extremely simple and completely reliable. Barber-Colman remote electronic sensing elements consist of a coil of temperature-sensitive wire. There are no moving parts, nothing to get out of order. Current flow through the sensing element changes as the temperature changes.

Pushing a button for the area to be checked closes the circuit between the sensing element and the indicator, unbalancing a bridge circuit which actuates the pointer.

A mirrored scale assures accurate readings even when the operator is standing at an angle to the instrument.

Extreme accuracy is assured. Temperature readings are not affected by normal line voltage fluctuations.

Temperature indication is independent of control elements. Malfunction of the control sensing element cannot cause an incorrect temperature reading.

For use with all types of control systems. May be added to an existing installation or incorporated into a new system, with or without remote control point adjustment.

For complete information and literature, call your local Barber-Colman Automatic Controls office or write.

"Better Control . . . Electrically"

BARBER-COLMAN COMPANY

Dept. U, 1302 Rock Street, Rockford, Illinois

BRIEFLY STATED NEWS ITEMS

"The Russian government, it is well known, has nearly completed the line of railway across Siberia to the Pacific Ocean. The contract for the western terminal, amounting to $7,000,000 has been let.

"The United States has been called upon already to furnish a great part of the equipment for this railroad."

This extract is from a rare 1900 issue of *Cold Storage*, one of many volumes donated to the Recold Museum of Refrigeration and Air Conditioning, it was announced by H. T. (Hy) Jarvis, founder of the museum and president of Recold Corp., Los Angeles, Calif.

The library contains over sixty bound editions of monthly and annual trade publications spanning the refrigeration and air-conditioning industry in the United States from 1899 to 1930.

Donated by York Div., Borg-Warner Corp., York, Pa., the library is a unique contribution, said Mr. Jarvis, because it is an historic record of the industry in the United States and its tremendous progress during the last sixty years.

ENGINEERS AND CONTRACTORS

The Minneapolis firm of BRUCH, MORROW AND KNAFLA, INC., consulting engineers, has announced the appointment of Raymond A. Diekman as an associate member of the organization. Mr. Diekman is a 1944 graduate of the University of Minnesota with a degree of Bachelor of Mechanical Engineering. In his new position he assumes the duties of chief draftsman. Prior to this change, he spent ten years with the firm of Magney, Setter, Leach, Lindstrom and Erickson, Inc., architects and engineers, and in that period had worked on many of their notable projects. . .

LIMBACH COMPANY, Cincinnati mechanical and metals contractors, broke ground for a new Cincinnati headquarters office building and

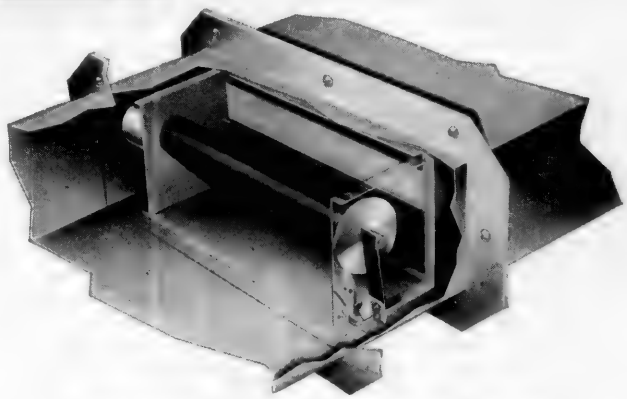
THE MARK OF QUALITY

BARBER COLMAN

Uni-Flo

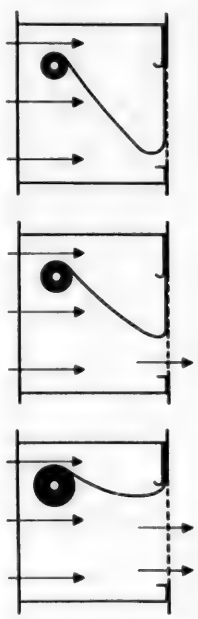
ENGINEERED AIR DISTRIBUTION

Self-operated control tames high-velocity air



Barber-Colman Model SCR constant volume regulator

...simplifies stabilization, maintains cfm delivery within ± 5%



Changes in static pressure cause the flexible diaphragm to move up or down automatically to control the open area of the discharge plate.

The Barber-Colman Model SCR constant volume regulator reduces high-velocity air to conventional velocities and delivers a constant cfm flow, regardless of pressure changes upstream.

This regulator is applicable anywhere in a duct system where there are changes in static pressure. No motor operator or other power source is required. The regulator is factory-set to meet job requirements but can be easily adjusted in the field should requirements change. Fully proved in service, this dependable control simplifies system design and stabilization.

Constant volume regulators can be used in low-velocity systems and provide self-balancing operation when installed in low-velocity branch ducts.

The Model SCR regulator also is available as an integral part of Barber-Colman complete double-duct control units which incorporate hot and cold air mixing valves actuated by a single motor operator.

New high-velocity manual — Ask for 52-page guide to design of high-velocity systems. Call your Barber-Colman air distribution field office or write.

BARBER-COLMAN COMPANY

Dept. U, 1102 Rock Street, Rockford, Illinois

7 OUTSTANDING ADVANTAGES OF NON-CLOG SEWAGE PUMPS

"from Chicago"

1. 50 years of pump manufacturing experience.
2. Balanced impellers passing large spheres provide quiet operation with high pump and high non-clogging efficiency.
3. Expansion joints in discharge pipe prevent pump distortion and resulting bearing failures.
4. Simple, dependable micrometer adjustment permits easy setting of impeller clearance in pump casing to compensate for normal wear, maintaining maximum efficiency.
5. Heavy ball thrust bearings are located well above floor level to prevent water splashing into bearings.
6. Packing boxes built into floor plates prevent leakage.
7. Heavy duty shafts and bearings eliminate vibration and provide long life.

FOR . . . handling sewage and drainage in buildings and industrial plants and for municipal sewage disposal.

SIZES . . . available in sizes from 4" to 8", with capacities from 50 to 3500 G.P.M.

Now available with *the new* SEALTRODE* Sealed Electrode Floatless Pump Controller . . . the *only* Controller featuring completely sealed Electrodes . . . positively preventing insulation or coating by grease or other corrosive elements.

Over 50,000 installations.

Write direct or contact Chicago Pump Company Distributors located in most principal cities for Bulletin 124-F and complete engineering data.

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1959 50 YEARS CHICAGO PUMP COMPANY 1909

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

Chicago Pump Company

6223 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

Briefly Stated

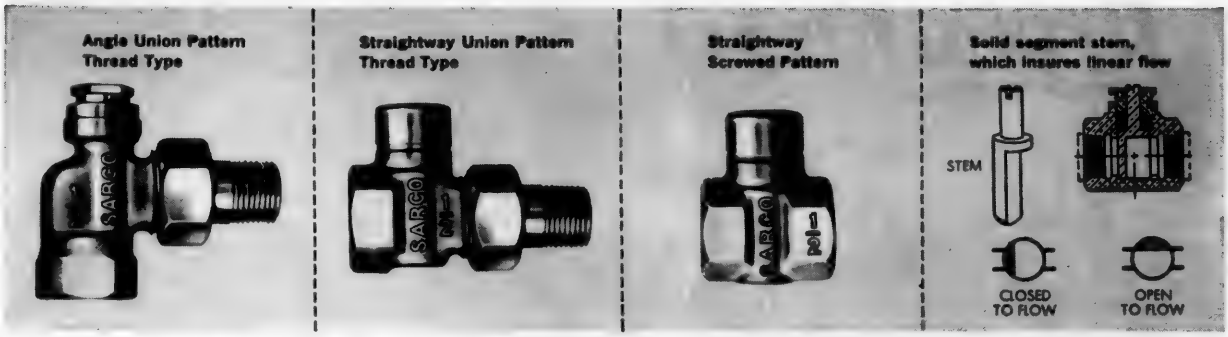
fabricating plant. The site is in the 5300 block of Vine Street in St. Bernard. Scheduled for completion this September, the plant will provide complete facilities for the fabrication of piping and air conditioning ductwork by its Mechanical Division and for the fabrication of industrial and architectural metal work by its Metals Division. Limbach Company, whose home office is at Pittsburgh, Pa., entered the Cincinnati market in December 1957. . .

James H. Ragon and Thomas L. Valentine are announcing the formation of their partnership under the firm name of RAGON & VALENTINE, Consulting Engineers. They have opened an office at 3093 Broad, Memphis 12, Tenn., for the practice of electrical and mechanical engineering. . .

Four executives of STONE & WEBSTER ENGINEERING CORP., New York and Boston have been elected vice-presidents. They are: Harold F. Cleary and Donald N. McCord, construction managers; M. H. Cutler, engineering manager; and William R. Prang, West Coast district manager. Mr. Cleary has been responsible for construction of industrial and power plant installations in the United States and Canada. Mr. McCord has supervised many large hydro-electric projects. Mr. Cutler is a specialist in design of power stations, industrial and chemical plants, as well as office and institutional buildings. Mr. Prang has been in charge of construction on industrial plants in various parts of the United States and Canada for the past seventeen years. . .

R. W. Goeldner is named chief engineer of CLEAVER-BROOKS SPECIAL PRODUCTS, Waukesha, Wis. (Special Products manufactures sea desalting equipment for marine, municipal, off-shore drilling, and pharmaceutical applications.) . . .

Walter M. Hassenplug is promoted from chief engineer to executive vice-president of ACME INDUSTRIES, INC., Jackson, Mich. His successor is Henry R. Krueger, who has been a project engineer with the company for the past two years.



for positive control
in balancing hot water systems, use **SARCO**

SOLID SEGMENT STEM BALANCING FITTINGS

Sarco Balancing Fittings use a stem having a segment of a circle, instead of the butterfly, stem on old type balancing fittings. Sarco construction gives you three solid advantages:

First, you get linear flow. Equal openings give you even throttling action and that can save you hours in balancing water systems. Second, when you set a Sarco fitting with this *solid segment* stem in the full open position you get no obstruction to flow. That means less pressure drop through the fitting. Third, Sarco Balancing Fittings have a Maximum Water Pressure Rating of 200 psi cold liquid — non-shock; 175 psi, 250° F temperature.

Available in both thread and sweat types

Sarco Balancing Fittings are available in both thread and sweat types, in all patterns. Also with *integral air vents*. Ready for prompt delivery, too: access boxes for balancing fittings; valves; air eliminators. Write for Bulletin 225.

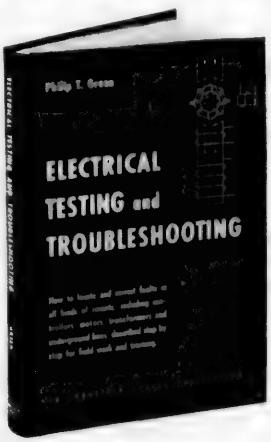
5896-F

SARCO—SARCOTHERM *AN AFFILIATE OF SARCO CO., INC.*

635 Madison Avenue, New York 22, N. Y.

LOCATE AND CORRECT FAULTS IN CIRCUITS

Expert Describes Tested Procedures In Testing and Troubleshooting



Let an expert explain how to locate and correct faults in circuits of all kinds. Just look at the table of contents below for a listing of the topics it covers in detail. *Electrical Testing and Troubleshooting* is written in an easy-to-understand manner. Only a basic knowledge of simple arithmetic is necessary to use and comprehend the principles and procedures set forth.

All of the troubleshooting procedures described have been tested in the field, and have been proved to be great time-savers, especially for locating obscure sources of trouble. Most of these tests can be performed with the equipment isolated from the power line—current is supplied by dry cells or residual magnetism—for greatest safety.

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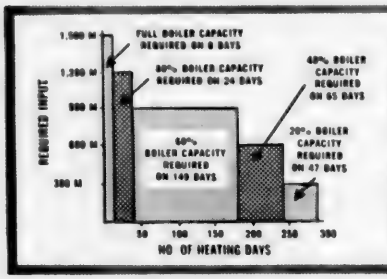
A 20%
GAS
SAVING
HERE
Here's where MultiTemp reduces gas costs by 20%. Return header has independent, differentially set aquastats that trigger each boiler, modulate input, and eliminate short cycling waste.

New MULTITEMP SYSTEMS

Make Gas Heat Competitive on "BIG JOBS"

Now even the big jobs requiring up to 3,600,000 BTU/hr input can enjoy the convenience and cleanliness of gas heat. A Hydrotherm MultiTemp system achieves true input modulation, brings gas consumption down and, being composed of multiple units, insures against service interruptions.

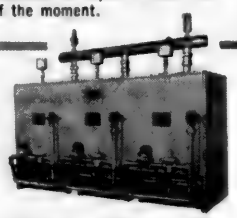
A MultiTemp battery of Hydrotherm boilers is hooked up with a separate aquastat for each boiler in the common return header. With each aquastat set for a different temperature, the boilers are fired or cut off independently. When the demand is small, only one boiler operates... when it is great or when the system is making a cold start, the complete heating plant is fired.



This graph shows the year-round load for a 1,500,000 BTU/hr hydronic plant in Bergen County, N. J., where degree days average 5600 to 6000. Heat was required for 293 days, but full capacity was needed for only 3% of that time.

Note how a single 1,500,000 BTU/hr boiler would have short cycled for 89% of the heating season at a great loss in efficiency. Note also how the MultiTemp battery of five 300,000 BTU/hr boilers modulated its input to meet the heating demand of the moment.

- *Input Ratings from 360,000 to 3,600,000 BTU/hr*
- *100 lbs. ASME Working Pressure*
- *Boilers Shipped Pre-Wired and Assembled*
- *Units Pass Thru 2'6" Doors*
- *Ideal for Volume Hot Water*



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Dept. 13-AH, NORTHVALE, NEW JERSEY

OTHER FAMOUS HYDROTHERM PRODUCTS: HydroTherm • HydroVector • HydroChiller • HydroFin

Briefly Stated

(Continued from page 140)

AWARD WINNERS

The annual Wolverine Tube Diamond Key Award was presented this year to Prof. H. M. Hendrickson, author of the outstanding technical paper related to refrigeration, published in Refrigerating Engineering. The announcement was made by John M. Dumser, director of sales for Wolverine Tube, Allen Park, Mich., Division of Calumet & Hecla, Inc. The 19th award winner, Mr. Hendrickson, is a professor of mechanical engineering, University of Washington, Seattle. His prize winning paper is entitled, "Saline Water Conversion by Freezing." Presentation was made by the AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS at its annual meeting held in Lake Placid, N. Y. . .

NEWS FROM THE INSTITUTES

The 1959 exposition of the NATIONAL SWIMMING POOL INSTITUTE, to be held in the New York Coliseum December 12-15, will be open to the general public, as well as to the pool trade. This year's show will feature a full-sized exhibition pool with daily water shows. More than 60% of the available exhibition space at the Coliseum has already been reserved by some 200 builders, manufacturers and suppliers for displays of full-size and miniature pools and of associated equipment, accessories, furniture and furnishings. A series of special seminars for pool builders, architects, engineers, landscape architects, public officials, and pool operators will be held simultaneously with the exposition, both at the Coliseum and at the Statler-Hilton Hotel, convention headquarters. . .

Letters of appointment are currently going out to 367 members of the BUILDING RESEARCH INSTITUTE from President Harold L. Humes requesting their service on nineteen committees of the Institute for the coming fiscal year. Chairmen of BRI standing committees who have so far accepted appointment in-

(Continued on page 144)

YOU CAN BUY AIR FILTERS WITH CONFIDENCE FROM MEMBERS OF . . .

The Air Filter Institute

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Fastest — Easiest Way to Seal Ducts and Apply Insulation

- Sticks instantly to anything.
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EXTRUDED ALUMINUM SHUTTERS

Shutters of modern design which give you ALL of these features: Lightweight, Full Weather Strip, Low Freight Cost, Easier installation, Concealed Pivot Pins, Rust and corrosion Proof and Natural aluminum finish with fluted frames.

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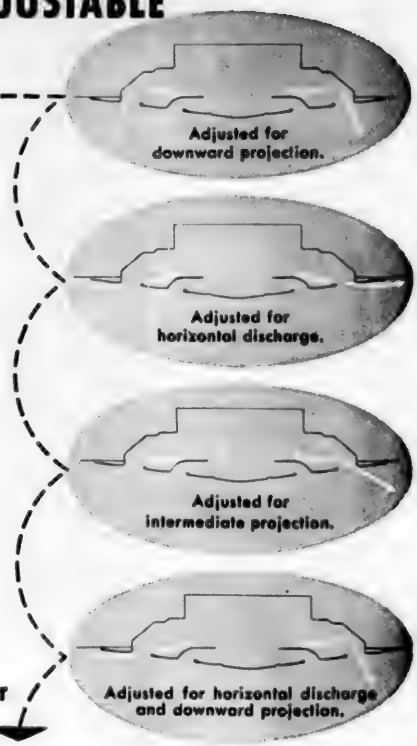
Take a look at a TRULY ADJUSTABLE Diffuser


Adjusted for downward projection.
Adjusted for horizontal discharge.
Adjusted for intermediate projection.
Adjusted for horizontal discharge and downward projection.
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TYPE "OA"

Here's a distinctively different diffuser with a radically new means of controlling air direction at four different angles of discharge simultaneously. *Without changing the position of the spinnings,* AGITAIR "OA" diffusers can be adjusted to put the air where you want it in one, two, three or four directions . . . *after installation.* Result: Segmentized . . . positive adjustability with Finger-Tip Air Direction Control.

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Contains complete data, performance charts, construction details, etc.

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AIR DIFFUSERS • FILTERS • EXHAUSTERS

SIDEWINDER OPERATOR
totally enclosed, low friction, powerful

NYLON BEARINGS
low friction, long lasting

CHEVRON PACKING
never needs adjustment

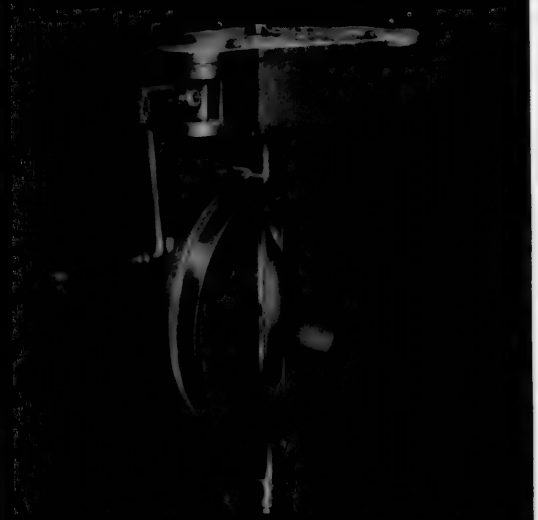
SHAFT
straight through, stainless steel or monel

DISC
one piece, cast in choice of materials

HYCAR SEAT
never needs replacement

BODY
cast iron or cast steel

the MONOFLANGE MARK II



the valve that industry demanded*

*The motivating force behind the creation of this, and other new products soon to be announced, was the obvious industry need for this type of equipment. Henry Pratt MARKET ORIENTED valves are all new for 1960.

Usually, the most significant contributions to industry stem from ideas born of experience. Such a contribution is the Pratt MONOFLANGE MARK II—a really different valve. The difference is in design and conception—for here is a valve designed to meet the ever increasing need for a compact and sensible 150# valve. Drop-tight and ideal for throttling service, the MONOFLANGE MARK II is a versatile valve. Even the manual and automatic operators are new—all enclosed, powerful, rugged, and reliable. For a high quality, reasonably priced valve, consider the MONOFLANGE MARK II. Full particulars are available. **Write for Bulletin 10DA**

HENRY PRATT®

Monoflange MK-II
RUBBER SEAT BUTTERFLY VALVE

Creative Engineering for Fluid Systems

HENRY PRATT COMPANY
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Representatives in Principal Cities

Briefly Stated

(Continued from page 142)

clude: Membership Committee, Robert W. Cutler, Skidmore, Owings & Merrill; Programs Committee, Frank Reynolds, Bird & Son; Finance Committee, Leon Chatelain, Chatelain, Gauger & Nolan; Publicity and Publications Committee, Joseph Schram, Building Products magazine; Research Committee, Leonard G. Haeger, Architectural Consultant; and Incentives Committee, Harold L. Hauf, Rensselaer Polytechnic Institute. Among these, twelve subcommittees of the Programs Committee, each devoted to a particular area of interest, and two subcommittees of the Publicity and Publications Committee are in the process of appointment. This total sets a new high for member participation in BRI activities, and bodes well for the caliber of technical programs and publications for the coming year, BRI says. . .

A study is underway at Battelle Memorial Institute, Columbus, Ohio, to formulate an industry-wide research program to improve oil-burner equipment and to develop new uses for fuel oil. The study is part of a long-range program which will coordinate pertinent research now being done independently by many organizations within the petroleum industry and elsewhere, and reflects AMERICAN PETROLEUM INSTITUTE'S growing interest in the position of oil burner equipment in the highly competitive market for home heating units.

UP ON TOP

Election of Russell E. Emrich, Sr., as president and chief executive officer of BOILER ENGINEERING & SUPPLY CO., INC., Phoenixville, Pa., was announced simultaneously with the news that Russel E. Keen, who had been president and treasurer of the firm, had been elected chairman of the board of directors and assistant treasurer, and that Donald R. Keen, who had served as assistant secretary and assistant treasurer, was elected secretary and treasurer. A new addition to the company's board of directors is Maurice Williams, consulting engineer of Baltimore, Md. . .

With the transfer and expansion of administrative sales, and engineering offices of SPRINGFIELD BOILER CO., Springfield, Ill., its wholly-owned subsidiary, to the Milwaukee headquarters of CLEAVER-BROOKS COMPANY, comes the announcement of the naming of F. W. Hainer to the presidency of the subsidiary. He is executive vice-president of the parent corporation. He, in turn, has named G. A. Rehm chief engineer; James Fletcher, director of manufacturing; and L. E. Stickler, sales manager. . .

BURGEONING BUSINESS

CHICAGO PUMP COMPANY celebrated its 50th anniversary in June with an informal open house at the LaSalle Hotel, Chicago. Over 450 consulting engineers, architects, contractors, health officials, and educators attended the two-day event. Guests were served a buffet lunch and cocktails, shown a display of new products, including sewage pumps, sewage comminuting machines, water booster pump, sewage and sump pumps, and a working model of a treatment plant.

RECENT APPOINTMENTS

Ben M. McDougall has been named field sales manager of BALTIMORE AIRCOIL COMPANY, INC., Baltimore, Md. In his new position, Mr. McDougall will spend the major part of his time working closely with the B. A. C. sales offices. He is well known in the Industry from his former position as general sales manager of Kennard Corporation in St. Louis and his association with ARI and ACA. . .

Appointment of Robert F. Elliott as sales representative, national accounts, for TACO HEATERS, INCORPORATED, Cranston, R. I., was announced. He had been Chicago representative for Keckley Company, manufacturers of steam and liquid control valves, and Chicago sales manager for General Blower Company. . .

Robert W. Carvell has been advanced to sales promotion and advertising manager of HENRY VALVE CO., Melrose Park, Ill. For the past two years he has been serving Henry

Super HEAVY DUTY Sewage Ejector

• SCREENLESS
• RUGGEDLY BUILT
• NON-CLOG IMPELLER

THE ECONOMICAL SEWAGE PUMP with the NON-CLOG impeller!

This WEIL Screenless Heavy Duty Non-Clogging Sewage Ejector is ruggedly built for years of trouble-free operation. WEIL Pumps of this design are still operating satisfactorily after 25 years of service.

This unit is completely factory assembled, economical to install — only one piping connection is required. Preassembly and factory testing insure LESS installation time and no "call-back" servicing.

Inherent in the design of this pump is an ample reserve of strength to meet the most severe conditions. The ease and simplicity of installation and the record of many years of trouble-free operation make this pump the logical choice with the engineer, contractor and owner.

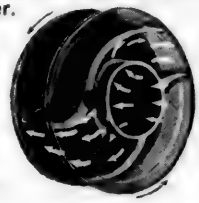

Fig. C-9001

This Two Blade NON-CLOG Impeller is the most important part of the screenless non-clog sewage pump. Not only does it effectively handle large diameter solids but it also passes rags and stringy material of various lengths which are washed into the sewage pit. Pumps with this impeller successfully handle difficult pumping jobs such as waste from public toilets, canning plants, hospitals and industrial installations.

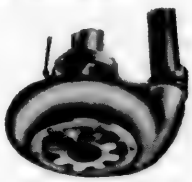

Fig. C-9021

This rugged pump casing with wide waterways permits unobstructed passage of the maximum solids handled by a non-clog impeller.

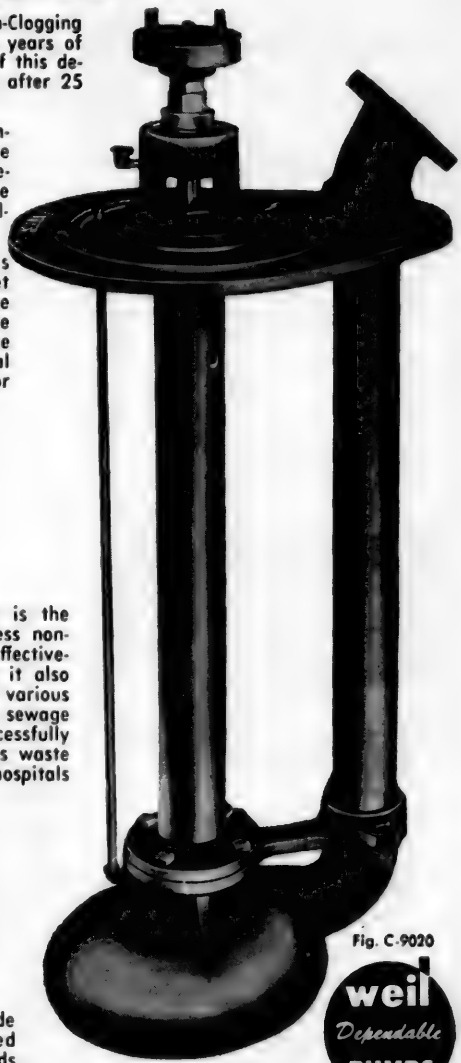

Fig. C-9020

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for FUME

CONTROL

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Made of strong neoprene coated cotton or nylon fabrics spiral wire reinforced.
For *all* kinds of fume and dust control, and ventilation uses.
Extremely flexible, durable, and lightweight.
Exceptionally easy to cut, install, connect, reuse, and relocate.
Sizes 1¼" thru 36" i.d.

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as Sales supervisor of their industrial activities. In the past thirteen years he has served as sales manager of Bohn's-Betz Division, Danville, Ill., on wholesaler activities, the former Kennard Corp., St. Louis, Mo., as assistant sales manager and as a field engineer for Alco Valve Company, also of St. Louis. . .

A. K. Johnson is named manager of the Cleveland office of ILG ELECTRIC VENTILATING CO., Chicago, Ill. Mr. Johnson has been with the firm since 1947, serving two years in its Chicago sales office, and then from 1949 until his recent appointment, in the Milwaukee office. . .

These recent changes have been made as part of an overall expansion program in the Advertising and Sales Promotion department of YORK DIVISION, York, Pa., subsidiary of Borg-Warner Corporation: Named as sales promotion managers are Kenneth J. Thompson and Henry H. Kirkpatrick; J. J. Donald Smith, formerly manager of advertising and sales promotion for the Engineered Machinery Division, is now advertising manager. His new assignment embraces the supervision of all national advertising activities. He is succeeded in his old job by Caron N. Ehehalt. . .

Recent bulletins from CRANE CO., Chicago, Ill., announce the following: promotion of W. D. LaRue, district manager of the company's mountain states area, to general manager of wholesaler sales, heading up a recently organized department which was created following the shift from company-owned branches in favor of independent wholesalers; the naming of Joseph A. Donahue as manager of sales promotion, in charge of promotion catalogs, and commercial research; the appointment of Ronald W. Lindsay to the newly-created position of director of sales, in charge of seven sales departments, including atomic energy, branch, engineering, export, wholesaler, services, and personnel-sales training; and election of Wesley A. Songer as executive vice-president. He held the same position with American Safety Razor Corporation. . .

Ralph K. Behr, a licensed professional engineer in New York, Illinois, and Massachusetts, is named manager of the New York district sales office of THE BABCOCK & WILCOX COMPANY'S Boiler Division. He succeeds Nicholas J. Connor, who has been appointed a sales consultant. Replacing Mr. Behr as manager of the division's Boston district sales office is Gerald S. White, former sales engineer. . .

Personnel promotions at RESEARCH PRODUCTS CORP., Madison, Wis., include: John G. Schutz, gen-

(Continued on page 148)

New officers of the American Society of Sanitary Engineering installed at the 53rd annual meeting held in Washington, D. C., July 19 to 24. Seated, left to right, J. Frank Warren, 2nd vice president; Edward J. Zimmer, 1st vice president; Arthur E. Whitney, president; James C. Church, 3rd vice president; James Shelton, 4th vice president. Standing, stand-in for Norbert Melnick, James E. Christie, W. F. Springmyer, Lyle M. Reading and John Risdon, respectively, 5th, 6th, 7th, 8th and 9th vice presidents; stand in for Verne Baker, Board of Directors, and Mike Mercury, treasurer.

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SPROCKET RIM
with Chain Guide
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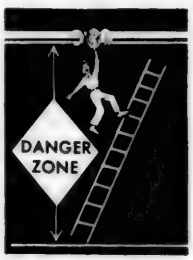
SAFETY ZONE

The distance between the floor of your plant and your overhead valves is a DANGER ZONE when piled up boxes or even ladders are used to reach the valves.



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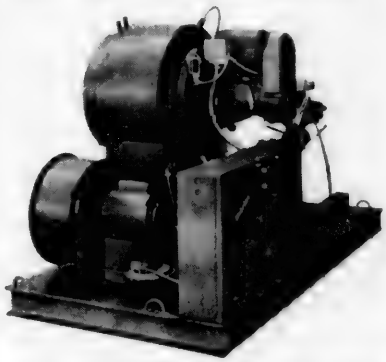

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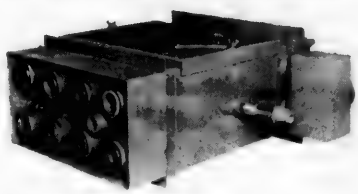

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3383 E. Layton Ave., Cudahy, Wisconsin
a product of STODDARD INDUSTRIES

Briefly Stated

(Continued from page 146)

eral sales manager; K. H. Lindquist, administrative assistant to A. W. Brown, vice-president for marketing; A. H. Hambrecht, production manager; Jerry Staebell, traffic manager; and Howard Hoveland, purchasing agent. . .

Election by the board of directors of three vice-presidents in the sales and manufacturing divisions of THE TRANE CO., La Crosse, Wis., was announced. William C. Dackis, promoted to vice-president of Heat Transfer sales, was formerly its manager. William D. Graham, Jr., promoted to vice-president, sales offices, will be in charge of all the company's sales offices in the United States and report to A. C. Menke, vice-president, Heating and Air Conditioning. John D. Cantwell, Jr., former works manager, is now the vice-president in charge of La Crosse Manufacturing. . .

Election of B. W. Moreland as vice-president of COPELAND REFRIGERATION CORP., Sidney, Ohio was announced. He will continue to head all Copeland manufacturing operations, the position he has held for the past year as general manager of manufacturing. Mr. Moreland came to Copeland in July, 1958 after seven years in charge of compressor manufacturing at General Electric, ten years at Carrier, and five years at Worthington. . .

John W. Eason is the new manager of the Baltimore Division of REVERE COPPER AND BRASS INCORPORATED. He has been manager of the company's aluminum industry sales in the New York executive office since October 7, 1957 and previously was manager of aluminum sales at Baltimore. He succeeds Jack F. Croasdale, a vice-president of Revere, who died suddenly on June 19th. Appointment of Arthur W. Wainwright as assistant manager of the Baltimore Division was also announced. . .

Roland A. Hazell, appointed manager, National Steel Boilers, Heating and Air Conditioning Div., NATIONAL-U. S. RADIATOR CORP., Johnstown, Pa., will be responsible for the promotion and sale of the company's national line of residen-

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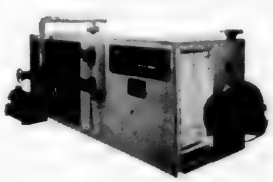

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WEKSLER INSTRUMENTS CORP
FREEPORT L. I. NEW YORK

Briefly Stated

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tial and commercial steel heating boilers. Before his new assignment, Mr. Hazell was manager of the company's Canadian branch for three years, and prior to that, he was manager of the Buffalo, N. Y., branch. . .

CARRIER CORPORATION, Syracuse, N. Y., has named three executives to newly-created senior staff positions. Frank R. Littlefield, until recently in charge of the Manning, Maxwell & Moore plant in Watertown, Mass., has been elected a vice-president and designated director of manufacturing. Walter H. Steitler, formerly president of Carrier - Houston Corporation and more recently assistant to the president, has also been elected a vice-president and will serve as director of marketing. Walter A. Grant, already a vice-president, has been named director of engineering. . .

* * *

Sol Wolpert, manager of the Chicago branch of NATIONAL-U. S. RADIATOR CORPORATION, died June 7, 1959. He joined United States Radiator Corporation, a company predecessor, in 1913 at its Minneapolis Branch. Transferred to the Chicago branch fourteen years later, he was named assistant branch manager in 1929 and in 1944 was appointed branch manager.

Robert K. Milward, prominent heating specialist for 47 years, died at his home in Detroit on July 3rd. He was manager of customer relations, of the company's Detroit Branch at the time of his retirement April 30, 1956. Mr. Milward began his career in 1909 as a forwarder in the Detroit plant of the U. S. Heater Company. He later served as branch manager in the company's Omaha office. With the merger of the U. S. Heater Company and U. S. Radiator Corporation, he became branch manager of the St. Louis office. In 1927, he was appointed Detroit branch manager for U. S. Radiator Corporation, a post he held for twenty-eight years.

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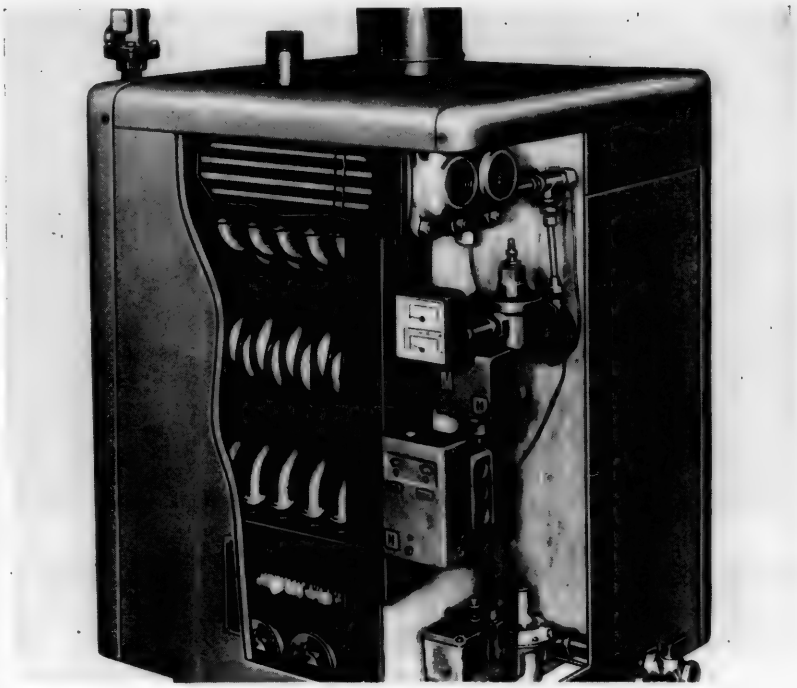

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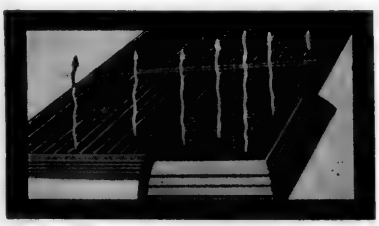

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Inside Front Cover — Item 200

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steam return lines made of new Byers' 4-D material are a formidable deterrent to steam condensate corrosion and its deleterious effects. Literature is available, including a special report.
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OVER 500 FLUSH VALVES .....
made by Coyne & Delany are installed in the West's largest office building in downtown Oakland. All flush valves in this Kaiser Center will be concealed in access boxes. Routine repairs will be somewhat more time consuming, hence the installation of efficient valves is particularly apt. Information available.
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using copper tube at the new Fairview State Hospital, Costa Masta, Calif., eliminates waste space in furred areas and allows ample headroom in the basement. More than 16,000 lb of Anaconda copper tube used. Bulletin available.
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COOLING-HEATING CONDITIONER ..
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THE ZINC COATING .....
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AIR DISTRIBUTION EQUIPMENT .....
is produced by Tuttle & Bailey on both East and West Coasts at top quality and competitive prices. Line includes devices and accessories for low pressure systems and a full selection of high pressure attenuation units and related equipment. Ad lists branch offices and authorized representatives in 35 states, District of Columbia. Information available.
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STANDARD OR SPECIAL MOTORS ....
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CENTRIFUGAL FAN EQUIPMENT .....
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NEW AIR-COOLED CONDENSERS .....
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Page 26 — Item 214

INDUSTRIAL HEATERS .....
from Lennox Industries, Inc., operate equally well with either gas or oil, and, in addition, have "push button" changeover. Engineering data are offered.
Page 27 — Item 215

FACTORY HEATING, VENTILATING ...
can be accomplished completely with Trane equipment. One source means one responsibility for the whole job. Lines are more versatile, more complete than ever before. New centrifugal roof ventilators, cabinet fans, Torrivent, steam specialties, and a wider range of anything you need. Information available.
Pages 28-29 — Item 216

HIGH TEMPERATURE PUMPS .....
for moving heat transfer liquids are offered by Buffalo Pumps. Well-known, hydraulically efficient, impeller and casing design. For all heat transfer problems, including vapor phase. Information available.
Page 31 — Item 217

AIR CONDITIONING EQUIPMENT ....
produced by American-Standard Industrial Div. permits you to select all the major components from one source with the attendant one-source responsibility for quality and performance in equipment designed, engineered, and manufactured to work together. Information available.
Pages 32-33 — Item 218

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

THERMOSTATIC SHOWER MIXER ..... offered by Lawler is of such advanced design that it will never go out of style. The Recesso is entirely recessed into the wall, eliminating dangerous protruding edges which might cause bodily injury or collect dirt or scum. A safe, sensitive, instant-acting control. Information available.
Page 34 **Item 219**

AIR DIFFUSION EQUIPMENT ..... is produced by Anemostat in an impressive variety to meet every architectural and engineering requirement. Trademark guarantees quality. Information on complete line is available.
Page 35 **Item 220**

FIBER GLASS DUCT LINER ..... offered by Johns-Manville keeps air ducts quiet and makes them more efficient. Of light weight material, resilient and strong, rolls are easy to cut and fit, as well as pleasant to handle. Provides maximum insulation value for dollar invested. Specification and installation data available.
Pages 36-37 **Item 221**

INDUSTRIAL DUAL-FUEL BURNER .... with integral air register is produced by Petro for natural or induced draft firing in capacities of 30 to 450 boiler hp, gas or oil. Burner handles the heaviest oil or any type of gas with precision and dependability. Literature and specification sheet available.
Page 38 **Item 222**

ZONE CONTROL CABINETS ..... from Buffalo Forge Co. simplify your air conditioning installations. Quiet, highly efficient units provide varying degrees of conditioned air for several zones. Bulletin is offered.
Page 39 **Item 223**

COOLING WITH GAS ..... keeps work efficiency high and operating costs down with Arkla-Servel units at First Federal Savings in Alhambra, Calif. The same compact system keeps employees warm in winter. Specific details available.
Pages 40-41 **Item 224**

REMOVABLE CORE GRILLES ..... are presented by Waterloo Register Co. Cores slip out easily and prevent damage to plaster or painted walls. Comprehensive catalog is offered.
Page 42 **Item 225**

COOLING TOWERS ..... from Halstead & Mitchell boast a 20-year guarantee. Specially treated wood decking resists rotting, fungus attack, and algae which accumulates and obstructs air flow in most other towers. Information is available.
Page 43 **Item 226**

COPPER TUBE ..... made by Bridgeport Brass is neatly summarized in booklet "Your Guide to Bridgeport Plumbing, Heating and Air Conditioning Products." Lists types, sizes, weights and strength of copper water and drainage tubes.
Pages 44-45 **Item 227**

AIR HANDLING, CONDITIONING ..... is handled in modern installation by capillary air washers and power roof ventilators offered by Clarage Fan. Equipment has reputation for faithful performance and operating economy. Bulletins describing units offered.
Page 46 **Item 228**

MONEY-BACK GUARANTEE ..... offered by Jenkins Valves is the same today as originally published 90 years ago. If not perfectly tight or if it does not hold steam, oil, acids, water or other fluids longer than any other valve, money is refunded. Information is available.
Page 47 **Item 229**

FOUR INDUSTRIAL HEATERS ..... from Dravo Corp. keep a 79,000 sq ft warehouse, with high roof areas and large access doors, warm during severest cold spells. Information on these, plus other services and products of the company, is available.
Page 48 **Item 230**

CENTRIFUGAL CHILLER ..... supplied by Chrysler is the heart of the air conditioning system in the new Memorial Auditorium in Greenville, S. C. The 500-ton unit costs less to install and saves operating expenses. Only 400-hp motor needed. Information on liquid chiller, which can be custom engineered to your needs, available.
Page 49 **Item 231**

MERGER NOTICE: .....
The incorporation of the Massachusetts Line into the Peerless Electric product parade now makes it possible for Peerless to supply fans and blowers with 4-inch to 86-inch wheels. Also, special units produced to customer, engineer and government specifications every day. Catalogs available.
Page 50 **Item 232**

ZONING VALVE ..... offered by Heat-Timer has 100% shut off for positive temperature control on steam, hot and chilled water systems. New brochure containing layouts, applications, customer benefits, technical data, and prices available.
Page 51 **Item 233**

ANY TYPE OF COOLING ..... problems, industrial or commercial, can be solved by Frick Co. engineers who will design, build and install the company's systems. Information is available.
Page 52 **Item 234**

GLASS FIBER DUCT LINER ..... offered by Gustin-Bacon conforms to strictest fire codes. Ultralite liner is now available with a newly developed and approved gray fire-resistant coating. The new product carries a flame spread classification of less than 25 and complies with all requirements of the Fire Underwriters. Specification data and samples available.
Page 53 **Item 235**

FISHMOUTHS SAVE 50% ..... or more over commercially available branch fittings. Made by H. K. Porter, they are available for branch connections 2 inches or over and are made from Schedule 40 pipe. Rated for working pressures to 55% of maximum run-pipe limits. Complete information, prices, and names of distributors available.
Page 111 **Item 236**

AIR-CONDITIONING EQUIPMENT .... from Thermal Engineering Corp. helps keep pilots cool in the flight simulator building of Eastern Airlines in Miami. Information is available.
Page 112 **Item 237**

FUEL OIL HEATER ..... from Davis Engineering permits direct use of boiler water and fuel oil in the same shell without danger of system contamination. Bulletin is offered.
Page 113 **Item 238**

NEW PRESSURE CONTROL ..... offered by Mercoid weighs only 1¾ lb, incorporating a single pole, double throw hermetically sealed mercury switch. Adjustable operating ranges from 1 to 20 and 1 to 30 psig. Bulletin available.
Page 114 **Item 239**

OFF-THE-FLOOR WATER COOLER .... made by Cordley & Hayes and called the Cordwall is the most important improvement in electrical water coolers in 30 years. Flush with the wall, it conceals all plumbing. Saves up to two-thirds of the space needed by standard coolers. Bulletin available.
Page 115 **Item 240**

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement. All advertisements are digested here except those that are received too late for inclusion in this listing.

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

CENTRAL STATION MANUAL ..... published by Drayer-Hanson contains 48 pages describing the company's popular 30-model central station air conditioning units (horizontal and vertical) as well as handy time-saving fan performance curves.
Page 116 Item 241

SAFE BOILER WATER CONTROLS .... manufactured by Magnetrol are also the simplest. A permanent Alnico magnet, located outside float chamber, links water level and electrical controls. This link eliminates mechanical parts normally subject to wear and fatigue failure. Catalog available.
Page 117 Item 242

ACCURATE TEMPERATURE READINGS are obtained in 3 to 5 seconds with the Alnor Type 2300 surface pyrometer. Large mirrored scale is direct reading. Bulletin is offered.
Page 118 Item 243

GAS-FIRED AIR MAKE-UP ..... with units manufactured by Aerovent increases production capacity and improves fan and heating efficiency. Units supply ample quantities of clean, preheated or cooled outside air to replace air exhausted by ventilating systems. Bulletin offered.
Page 119 Item 244

CENTRALIZED CONTROL SYSTEM .... from Minneapolis-Honeywell features modular building block design which offers greater economy and new flexibility. It lets one man do the work of a crew. Information is available.
Insert bet. 120-123 Item 245

DRYER, FILTER, PRV STATION ..... are among new products offered by Honeywell. Air dryer extracts moisture from compressed air for pneumatic control. Highly efficient filter removes all dirt and oil from high pressure air. Pressure reducing valve station maintains source of control air at the precise pressure regardless of drain on the system. Information available.
Insert bet. 120-123 Item 246

BELTED ROOF VENTILATOR ..... is propeller-type unit manufactured by New York Blower. Galvanized construction and quality details. Bulletin discusses units in capacities from 4450 to 33,900 cfm, and in smaller direct-drive sizes.
Page 125 Item 247

POWER DRAFT UNIT ..... for industrial, residential and institutional exhausting, is available from Quickdraft. It increases heating and combustion efficiency with no motors, fans or bearings in exhaust lines. Engineering data are offered.
Page 126 Item 248

HEATING PUMPS ..... available from Skidmore are built for performance. A unit is designed for each and every heating requirement. Included are an easily accessible, compactly designed condensation pump and a close-coupled, mechanical shaft-seal vertical pump. Bulletins available.
Page 127 Item 249

FOR WALL-HUNG FIXTURE ..... installations, Jay R. Smith Mfg. Co. recommends its long barrel adjustable fittings and chair carriers. They save time, labor, material. Information available.
Page 128 Item 250

AIR COOLED CONDENSER ..... —the Aircon by McQuay—provides the ultimate in flexibility by combining refrigerant condensing with heating and ventilating. May also be used for exhaust ventilation, saving both time and money in installation, maintenance, and operating costs. Installed indoors or outdoors. Information available.
Page 129 Item 251

ARCHITECTURAL GRILLES ..... for every type of installation are offered by A-J Mfg. Co. New catalog contains complete specifications. Practically no limit on size, and grilles can be made to exact order from steel, aluminum, bronze, monel, or stainless. New convector type has pencil-proof slots for cooling or heating outlets, free area of 54%, for installation in sills, side-walls, ceilings, and floors.
Page 130 Item 252

ROOF-MOUNT CONDITIONERS ..... offered by Ventil-Aire give more benefits at less cost. No costly ducts. No boiler used. No air handling or compressor space required. No water towers. No intricate control wiring. Specification on units of 5, 7½, and 15 tons available.
Page 132 Item 253

THERMO EXPANSION VALVES ..... offered by Alco are engineered to retain product leadership. Power element life increased ten times. Rapid response remote bulb and well available when specified. Easy capacity changes or cleaning without breaking connections. Bulletin available.
Page 133 Item 254

ALUMINUM DOOR LOUVERS ..... offered by Construction Specialties are precision engineered into neat, attractive and practical units. Though competitive with sheet metal assemblies they have many attractive qualities available only in extrusions. New catalog available.
Page 134 Item 255

HOT WATER HEATER ..... of the automatic, commercial type is offered by Ewing Mfg. Co. It is called the low cost answer to the hot water problem for laundries, restaurants, motels, schools and apartments. Information is available.
Page 135 Item 256

SUPPLY PUMPS ..... from Webster Electric are available in capacities to 575 gph. They handle all furnace oil with the extra measure of dependability required for commercial and industrial applications. Engineering bulletins are offered.
Page 135 Item 257

TOMORROW'S HEATING ..... is provided for by the installation, today, of the Cyclotherm steam and hot water generator. Unit is built under one roof and shipped fire-tested and ready to operate. Up to one-third smaller than any other package of the same capacity. Information available.
Page 136 Item 258

CHECK VALVE ..... offered by Watsco is combination spun end check valve and strainer, non-electric but magnetically operated. It is so finely calibrated that a fraction of an ounce of pressure will open. No springs. Illustrated catalog available.
Page 137 Item 259

FLEXIBLE DUCT CONNECTION ..... from Cain Mfg. Co. is prefabricated — simply pull out desired length from dispenser-type carton, roll into round duct or form into square duct. Information is available.
Page 137 Item 260

NO ONE FILTER ..... does all jobs or meets every need. That's why filters from Air Filter Corp. are engineered to the job to offer more effective dust collection. Bulletins are available.
Page 137 Item 261

Ad-Digest

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REMOTE INDICATION ..... of temperature at eye level offered by Barber-Colman. There is no limit to the number of points monitored by a single instrument. Extreme accuracy is assured. For use with all types of control systems. Complete information and literature offered.
Page 138 Item 262

SELF-OPERATED CONTROL ..... produced by Barber-Colman tames high-velocity air. Constant volume regulator simplifies stabilization, maintains cfm delivery within plus or minus 5%. Can also be used in low velocity systems and provides self-balancing operation when installed in low velocity branch ducts. New 52-page manual offered.
Page 139 Item 263

NON-CLOG SEWAGE PUMPS ..... by Chicago Pump Co. offer these advantages: (1) Fifty years of manufacturing experience, (2) Quiet operation with high efficiency, (3) No distortion, (4) Simple micrometer adjustment, (5) Heavy ball thrust bearings, (6) No leakage, (7) Heavy duty shafts for long life. Bulletin available.
Page 140 Item 264

BIG GAS HEAT UNITS ..... offered by Hydrotherm, Inc., enable the "big" jobs, requiring up to 3.6-million Btu, to enjoy the convenience and cleanliness of gas heat. MultiTemp system achieves true input modulation, limits gas consumption. Catalog is available.
Page 142 Item 265

NEW DIFFUSER ..... made by Air Devices, Inc., has radically new means of controlling air direction at four different angles of discharge simultaneously. The result is positive adjustability with finger-tip air direction control. Bulletin offered.
Page 143 Item 266

AIR FILTER INSTITUTE ..... lists its membership in ad. You can buy air filters with confidence from these members. Information available.
Page 143 Item 267

DUCT-SEALING TAPE ..... from Arno Adhesive Tapes, Inc., provides the fastest, easiest way to seal ducts and apply insulation. Free sample, information are offered.
Page 143 Item 268

EXTRUDED ALUMINUM SHUTTERS .... from Elgo Shutter & Mfg. Co. are of modern design, light weight, fully weather-stripped, easier to install, and are rust and corrosion proof. Complete specifications are available.
Page 143 Item 269

COMPACT, 150-LB VALVE ..... is called the Monoflange Mark II and designed by Henry Pratt Co. to meet the ever increasing need for a sensible valve at this rating. Drip-tight and ideal for throttling service, it is a versatile valve. Bulletin available.
Page 144 Item 270

HEAVY DUTY SEWAGE EJECTOR ..... offered by Weil Pump is screenless, ruggedly built, and has a non-clog impeller. New bulletin explains how construction of unit guarantees many years of trouble-free operation. Some units still operating satisfactorily after 25 years of service. Only one piping connection required.
Page 145 Item 271

FLEXIBLE HOSE ..... from The Flexaust Co. is adaptable for all kinds of fume and dust control and ventilation uses. It is durable, lightweight, and easy to install. Details are available.
Page 146 Item 272

GAS AND OIL BURNERS ..... from The Webster Engineering Co. are available, large or small, single or dual fuel, packaged or field assembled. Bulletin is offered.
Page 147 Item 273

ADJUSTABLE SPROCKET RIM ..... with chain guide, offered by Babbitt, changes a danger zone into a safety zone when overhead valves are so equipped. Pipe layout simplified. Units fit any size wheel, are easy to install. save time and money. Information available.
Page 147 Item 274

ELECTROSTATIC FILTERS ..... produced by Stoddard Industries under the trade name Dust-magnet, are permanent. They rinse clean in a jiffy for immediate replacement in air conditioners and furnaces. Non-clogging, they need no oil coating. Information available.
Page 148 Item 275

HOT WATER GENERATORS ..... manufactured by International Boiler offer truly significant savings in modern hot water heating systems. With these Thermojet generators, temperature differentials up to 200 deg F are in use and are recommended, effecting even greater savings. Full details offered.
Page 149 Item 276

PREFABRICATED AIR DUCT ..... by Wiremold eliminates collars or clamps. Two lengths are joined simply by screwing. The result is that air flow is not restricted. Saves time. Odd lengths are saved for neat use on next job. Information available.
Page 150 Item 277

NEW INSTRUMENT BULLETIN ..... shows you how to specify Weksler pressure gages, industrial, dial, and recording thermometers, recording hygrometers, and bi-metal dial thermometers. Gives at-a-glance information said to be a great time saver. Includes most of the basic instruments needed in air conditioning, heating, ventilating, plumbing, and piping.
Page 150 Item 278

ECONOMICAL WATER HEATER ..... made by Bryan Steam is oil or gas fired to meet your requirements, no matter how small or how large. Indirect heat exchanger method provides low cost hot water, economies, and compactness. Catalog available.
Page 151 Item 279

AIR-COOLED CONDENSER ..... eliminates fans, noise, and maintenance. Edwards Engineering offers a method that for the first time makes possible the elimination of cooling towers. Requires no electrical power. Water is not used, hence there is no water treatment problem. All sizes. Technical data available.
Page 152 Item 280

VALVE LINE ..... bearing the name Henry carries with it complete assurance of on-the-job satisfaction. Includes packless, packed, and wing cap type shut-offs; piston and diaphragm type pressure relief valves; spring loaded and free floating type flow checks; sealed and cartridge type filter driers; and all types of strainers. Information available.
Inside Back Cover Item 281

FLOW SWITCHES ..... offered by McDonnell & Miller do many jobs. They will actuate a signal light, sound an alarm, stop or start motors, start or stop automatic burners, and actuate metering devices. Bulletin offered.
Back Cover Item 282

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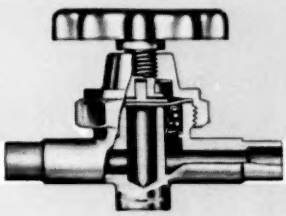

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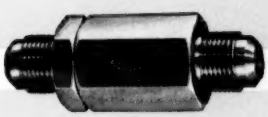
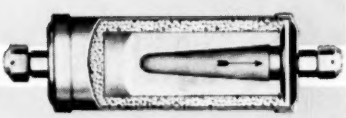
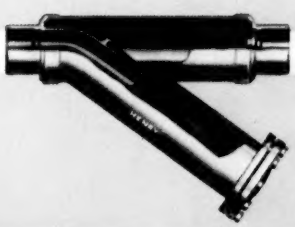


FILTER-DRIERS & Driers
Sealed and Cartridge Types



STRAINERS—All Types
Sealed and Cleanable

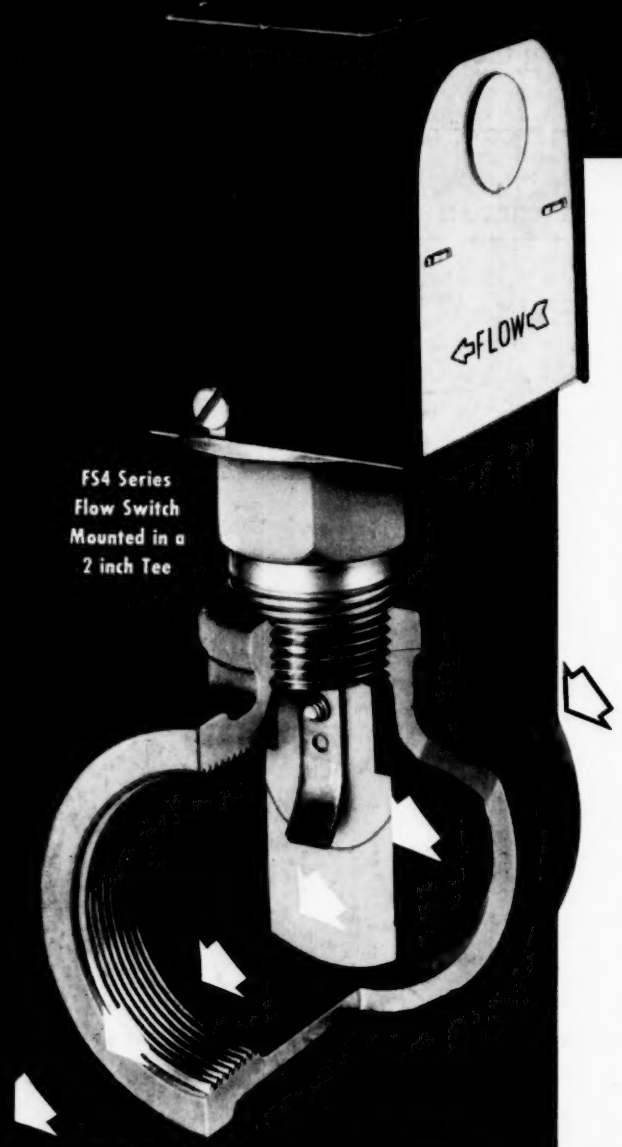


HENRY VALVE COMPANY

For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.

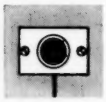
McDONNELL
Flow Switches



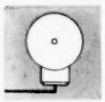
FS4 Series Flow Switch Mounted in a 2 inch Tee

Do you know how many jobs these switches can do?

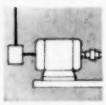
Look at the FS4 Series Flow Switch illustrated here. What you see is a compact, well-built switch that either makes or breaks a circuit (as required) when liquid flows or stops flowing. Yet in this versatile device you have both the most economical way and the most positive way of starting or stopping a signal, an alarm, a motor, a metering device—anything electrically operated. Just to highlight a few uses:—



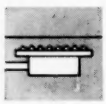
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



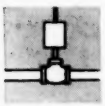
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

Think it over! Some of these uses may suggest some related problem the FS4 can solve for you right now. Notice the facts about its construction and service range opposite.

McDONNELL & MILLER, *Inc.*, 3500 N. Spaulding Ave., Chicago 18, Ill.

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Mail to: McDonnell & Miller, *Inc.*, 3500 N. Spaulding Ave., Chicago 18, Illinois

McDonnell quality throughout:

Compact switch with positive snap action. Removable cover and two knockouts for easy wiring. Phosphor bronze sylphon seals assembly leaktight from line. Paddle made in segments to fit any pipe from 1" through 3". FS4 series, illustrated, is for maximum working pressure 100 psi; maximum temperature, 300° F., in types as follows:

FS4 Closes with flow, opens with no flow.

FS4R Opens with flow, closes with no flow.

FS4-3 Single pole, double throw switch. Opens and closes two separate circuits with flow. Closes and opens same two circuits with no flow.

Underwriters' Listed

● Model E-2 available for larger pipe sizes and pressures to 150 psi.